National Park Service
U.S. Department of the Interior

Big South Fork National River and Recreation Area
Oneida, Tennessee

Environmental Assessment

For the
Fire Management Plan

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U.S. Department of the Interior
National Park Service
Big South Fork National River and Recreation Area
Kentucky and Tennessee

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

INTRODUCTION

The Big South Fork National River and Recreation Area (National Area), established by Congress in 1974 (P.L. 93-251) and managed by the National Park Service (NPS), is composed of approximately 123,000 acres situated on the Cumberland Plateau, a rugged scenic area in southeastern Kentucky and northeastern Tennessee (Figures 1 and 2).

According to the enabling legislation, the National Area was established:

> "(F)or the purpose of conserving and interpreting an area containing unique cultural, historic, geologic, fish and wildlife, archeological, scenic, and recreational values, [and] preserving as a natural, free-flowing stream, the Big South Fork of the Cumberland River…for the benefit and enjoyment of present and future generations, the preservation of the natural integrity of the scenic gorges and valleys, and the development of the area's potential for healthful outdoor recreation."

This environmental assessment (EA) was prepared in compliance with the National Environmental Policy Act of 1969 and its implementing regulations. Three alternatives, including a No Action Alternative, were developed and analyzed, and are included in the Alternatives Section. In accordance with National Park Service policy, an environmentally preferred alternative has been identified. The EA will be made available to the public for a 45-day review and comment period. Upon completion of the public review, the National Park Service will assess public comments and modify the preferred alternative as necessary. A Finding of No Significant Impact (FONSI) would then be prepared, or the agency would begin the environmental impact statement (EIS) process.

This is a programmatic EA in that it analyzes the impact of the draft Fire Management Plan for the National Area. Additional site specific surveys would be performed prior to any prescribed burn to identify and mitigate any potential environmental impacts associated with that burn. These mitigating actions would be incorporated in the burn plan for each individual prescribed fire.

Figure 1 - Big South Fork National River and Recreation Area Region and Vicinity Map

Figure 2 – Big South Fork National River and Recreation Area Map

1.0 PURPOSE AND NEED

Over the past ten years (1991 through 2001), 36 wildland fires were suppressed on NPS lands in Big South Fork NRRA. Records indicate that 7317 acres were burned (Shared Application Computer System 2001). Service policy requires that all National Park Service units with vegetation that can sustain fire have an approved Fire Management Plan (FMP). All FMP's must relate fire management objectives with firefighter and public safety and natural and cultural resource management objectives. The Wildland and Prescribed Fire Management Policy directs federal agencies to achieve a balance between suppression to protect life, property and resources, and fire use to regulate fuels and maintain healthy ecosystems. The guiding principles established by the Wildland and Prescribed Fire Management Policy that will be addressed in this document include:

- The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
- Sound risk management is a foundation for all fire management activities.
- Fire management plans and activities must incorporate public health and environmental quality considerations.
- Fire management programs and activities are to be economically viable, based upon values to be protected, costs, and land and resource management objectives.
- Fire management plans must be based on the best available science.

Fire has long been recognized as a disruptive force in nature that can impact vegetative arrangement and species composition, as well as the animals that depend on these habitats. The role of natural fire in the environment has been obscured over the past several centuries due to the intervention of Native Americans and Europeans (Martin 1989). It is surmised that settlers to the region had an even larger impact on the environment than did Native Americans. It is highly probable that they burned too frequently, during times natural fire would not have occurred, and in locations where fires would rarely be sustained (Martin 1989). Additional agents of change over the past century and a half such as logging and agricultural practices have resulted in an area covered almost entirely with second-growth forests that are less than 100 years old (Byrne 1964, Campbell and Newton 1995).

Many state-listed plants occurring in the Big South Fork region, some more common only decades ago, are rare today because of the absence of fire (Campbell et al. 1990). As recently as the mid -1980's, several colonies of the fire adapted, federally endangered red-cockaded woodpecker (*Picoides borealis*) were found within a twenty-mile radius of the park, with some colonies in the immediate vicinity (USDA Forest Service 1995). In 1994, five known active clusters were located on the Daniel Boone National Forest that adjoins the National Area (Costa and Walker 1995).

Of the 145 endangered and threatened rare plant species in the United States, 134 benefit from fire or are found in ecosystems adapted to fire (EPA 1999). The federally endangered chaffseed (*Schwalbea americana*), for example, is a species that exists on sandstone knobs and inland plains where frequent, naturally occurring fires maintained these sub-climax communities (USDA Forest Service 1995). There were several historical collections of the plant in Tennessee and Kentucky, including a 1935 collection by Braun from a “sandstone knob” along the Alum Creek Road (KY 700) in the vicinity of the National Area (Campbell 1990b). Repeated searches for this species have been unsuccessful. Fire maintained grassland communities (barrens) having a relatively high diversity of native species, once more common in size and extent, are now restricted to a few patches along old backcountry road margins, and will soon be extirpated (Campbell, et al. 1990a). The loss of the native barrens vegetation has had an adverse impact on grassland birds and other species that depend on this type of habitat (Campbell, et al. 1990a).

Wildland fire may also have an adverse impact on the environment. Certain plant communities and animal species occupy sites that seldom, if ever support wildland fire. In some cases these sites can be relatively small (Leon Konz, personal communication). Wet sites such as swamps and bogs and micro sites below seeps and springs, moist north facing slopes, mixed mesophytic communities, and riparian areas along streams or rivers are a few examples. In other cases, the long-term exclusion of wildland fire has resulted in plant communities that have so altered a site that the area can only tolerate low intensity fire (e.g.: a Red maple [*Acer rubrum*] dominated stand) (Olson 1998, USDA Forest Service 1998).

During periods of drought or abnormal environmental conditions (low relative humidity, high winds, low fuel moisture), wildland fire can consume duff and kill vegetation in wetter sites that would not burn under normal conditions when the site would be too moist to burn. Similar effects can occur if an area burns too frequently under a variety of conditions or during hot, dry conditions when wildfires have the potential to ignite the overstory tree crowns. The results can be dramatic. Wildland fires under the previously described conditions can result in high levels of tree mortality and open the area to invasion by other species, thereby changing the entire plant and animal species composition (Olson 1998). Secondary changes as the result of wildland fire under adverse conditions may include impacts to water and air quality, the creation of even-aged stands, insect invasion and fungal impact, and the loss of plant and animal species diversity.

In order to more fully understand the role fire played in the environment, the National Area is completing a study of the fire ecology of the Big South Fork area and will use the results to better refine the fire management program.

The National Area is significant as a cultural landscape because it preserves examples of development patterns unique to the upper Cumberland Plateau. As of this writing, five landscapes located in the National Area are potentially eligible for listing in the National Register. The National Area is required by Service policy to maintain these cultural landscapes. However, the associated fields and pasturelands are slowly being lost to the invasion of exotic species, and the encroachment of woody species, and the structures are at increasing risk from wildland fires as brush and other vegetation encroaches.

Levels of hazard fuels exist due to southern pine beetle infestations and recent winter storms, which produced acres of heavy accumulations of dead, and down timber, often arranged like jackstraws. The presence of these and other heavy concentrations of fuels near the boundary or adjacent to oil wells and tank farms can make the management and control of wildfires difficult, and place fire suppression forces and the public at risk.

Given the issues described above, the Big South Fork National River and Recreation Area needs a Fire Management Plan that will utilize a range of fire management strategies consistent with current knowledge. The long-term objectives for this action are to reintroduce fire as a natural ecological process and restore habitats to meet specified resource objectives, while addressing fire fighter safety, protection of park resources and developments, and surrounding land uses and improvements. Specifically, this environmental assessment analyzes the suppression of unwanted ignitions, introduction of fire on a limited basis to achieve management objectives, and mechanical hazard fuel reduction treatments in specific areas.

2.0 ALTERNATIVES

Under all alternatives, initial attack suppression actions will be taken on all human-caused wildland fires and escaped prescribed fires. Initial attack suppression actions would provide for public and firefighter safety, protect public and private resources, and utilize techniques that would cause the least impact to the National Area's natural and cultural resources.

Throughout the National Area, the use of suppression resources would be constrained as follows:

- Fire engines and other vehicles would not be driven off established roads and multiple-use trails without the approval of the Superintendent.
- Tractor plows or dozers would not be used without approval of the Superintendent, unless there was imminent threat to human life or private or public property.
- The use of motorized equipment is prohibited in the gorge except in emergencies.
- Natural topographic boundaries (e.g., ridge tops, streams) and existing trails/roads will be used as control lines where feasible. Leaf blowers and burn-out zones will be used to create fuel breaks, thereby reducing the need to dig hand lines.
- During and after wildland fire suppression, snags will be removed only in proximity to firelines, and then only when snag presence poses a risk to fire containment or to firefighter safety.
- Handtools and chainsaws would be used in a manner that results in the least impact to natural resources.
- The use of aerial retardant will only be considered upon immediate threat to life or developments. Retardant use will be consistent with Interagency Standards for Fire and Fire Aviation Operations (Interagency Standards for Fire and Fire Aviation Operations Task Group 2004) except where the National Area has developed more stringent requirements. Every effort will be made to maintain a minimum 300-foot retardant exclusion zone around all seeps, Clear Fork River, New River, Big South Fork River and all tributary streams, as outlined in the Standards. In the section of river bounded on the south by North White Oak Creek and bounded on the north by the confluence of Bear Creek, the retardant exclusion zone will be extended to the natural gorge boundary for the Big South Fork River and to portions of major tributaries (Troublesome Creek, Difficulty Creek, Williams Creek, No Business Creek, Parch Corn Creek, Station Camp Creek, Laurel Fork of Station Camp, North White Oak, Laurel Fork of White Oak Creek) (Figure 1). In all zones, retardant may be used in emergency situations that involve potential loss of human life. Retardant may also be used to prevent destruction of park developments (Headquarters complex, Bandy Creek complex, Station Camp Horse Camp, Bear Creek Horse Camp, Blue Heron complex) or consumption of structures associated with identified cultural landscapes (Lara Blevins, Litton-Slaven, Oscar Blevins). However, because of the proximity to the creek, retardant will not be used on the Charit Creek cultural landscape, except when human lives are threatened.

2.1 Alternative A – No Action. Suppress all wildland fires.

Under this alternative no changes from current procedures would be implemented. All wildland fires would be managed using an appropriate management response. Fire suppression personnel would, in a cost-effective manner, seek to limit the spread of a fire as quickly as possible, while ensuring public and firefighter safety and protecting the National Area's natural, cultural and historic resources, and private and other public property.

In many cases, an appropriate management response would entail the deployment of firefighters with handtools and engines to control the fire as quickly as possible. Another technique that could also be successfully used is indirect attack, where suppression forces burn out fuel in advance of the fire, using existing roads and trails as control lines.

In the event of the report of more than one fire, the highest priority would be given to wildland fires that have potential to adversely affect human life or safety, or to spread onto private or other public lands outside the boundaries of the National Area or threaten oil and gas wells or developed sites located within the boundaries of the National Area.

Mechanical hazard fuel reduction to achieve resource management objectives would be used on a limited basis (in fields, along park boundaries, and to protect structures). Prescribed fire would not occur under this alternative.

2.2 Alternative B – (Preferred) Suppress all wildland fires and use prescribed fire to achieve resource objectives.

Under this alternative, wildland fires would receive an appropriate management response with the same control objectives described in Alternative A.

Prescribed fire would initially be used on a limited basis to reduce accumulations of hazard fuel, maintain cultural landscapes, and in conjunction with an approved Integrated Pest Management Plan (IPM), control exotic species.

Prescribed fire would only be used when the prescriptive parameters are met. A prescription includes measurable criteria that define conditions under which a prescribed fire may be ignited. These criteria include fuel moisture, weather parameters, holding and contingency forces, ignition sequence, desired fire behavior characteristics, air quality and public health considerations, and measures to be taken and techniques to be used to reduce the impacts of the operation. Pre-burn and post-burn monitoring would be used to determine if treatment objectives were being met.

Prescribed fire and mechanical hazard fuel reduction would be used to reduce accumulations of hazard fuels around historic structures, developed areas, and near park boundaries, to reduce the likelihood of wildland fire negatively impacting National Area resources or spreading onto other public and private lands. In some cases, the preferred treatment would be only prescribed fire, in others, only mechanical means would be used, or the two treatments would be used in combination to achieve the desired results. A likely scenario where both treatments could be used would include cutting dead and down timber into manageable lengths, chipping larger pieces and scattering smaller branches. The area would then be burned under a predetermined set of conditions (prescription) to reduce the smaller materials that, under dry conditions, would contribute to control problems.

Based on the training and experience level of the park staff and the projects identified to date, prescribed fire would be used to treat an average of 800 acres annually over the next five years. During that period of time, the Resource Management Division would identify additional units for treatment. A list of proposed prescribed fire treatment areas that have been identified to date and a map of their locations can be found in Appendix EA-B.

Scheduling of the various units for treatment would depend on environmental conditions and the availability of required staffing, rather than arbitrary dates. All factors associated with the burn would have to meet parameters indicated in the prescribed burn plans before a burn could be implemented. It is possible that prescribed fire would not be used in some years due to lack of adequate staffing or favorable weather.

NPS would develop a plan for monitoring fire effects prior to implementing any prescribed fire. Monitoring results would be used to fine-tune prescriptions, as necessary, to ensure resource management objectives will be achieved.

2.3 Alternative C – Full use: Use the full range of fire management options available for fire suppression, ecosystem restoration, and hazard fuel reduction.

Under this alternative, human-caused wildland fires would receive an appropriate management response with the same control objectives described in Alternative A.

Prescribed fire and mechanical hazard fuel reduction would be utilized as outlined in Alternative B to reduce the likelihood of wildland fire negatively impacting National Area resources or spreading onto other public and private lands. Prescribed fire would be used to a greater extent than indicated in the second alternative to maintain cultural sites and restore fire to the ecosystem when appropriate, based on further studies of the fire ecology of the National Area.

The major difference between this alternative and Alternative B is that under this alternative, a lightning-caused wildland fire occurring in the National Area would receive appropriate management response based on prescriptive parameters that consider potential benefits to resources that may occur as a result of the fire. Predetermined control objectives would allow lightning-caused fires to burn within current and predicted weather parameters. This would ensure the fire would meet stated resource objectives in a predetermined area. Lightning-caused wildland fires ignited outside the prescriptive parameters would be suppressed.

Lightning-caused fires would be monitored to ensure the fire remained within a designated area, the desired resource objectives are achieved, air quality and water quality are not adversely impacted, and the fire does not damage historic or cultural resources or threaten life or property. Current and expected weather would be monitored and tracked. The National Area would ensure sufficient wildland firefighting resources are available to contain the fire in the event the weather changes unexpectedly or if the fire exceeded the pre-established prescription parameters.

NPS would develop a plan for monitoring fire effects prior to implementing any prescribed fire. Pre and post-burn monitoring would be used to determine if treatment objectives were being met. Monitoring results would be used to fine-tune prescriptions to ensure resource management objectives will be achieved.

2.4 Environmentally Preferred Alternative

The environmentally preferred alternative is determined by applying the criteria suggested in the National Environmental Policy Act of 1969 (NEPA), which is guided by the Council on Environmental Quality (CEQ). The CEQ provides direction that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101:

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
4. preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;
5. achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Alternative A, suppress all wildland fires, fails to meet the policies outlined above. Full suppression measures leads to unhealthy ecosystems and catastrophic fires.

Alternative B is the environmentally preferred alternative. Because so little is known about past fire history and the role fire played in the area, the environmentally preferred alternative at this point in time would be one that includes suppression, mechanical hazard fuel reduction and prescribed fire to achieve cultural and resource management objectives. This alternative strives to and meets policies 1-6 to varying degrees.

Alternative C also strives to and meets policies 1-6, but the current lack of understanding about the role of fire in this ecosystem warrants further study and review. When further fire ecology studies are completed and the role fire plays in this ecosystem is more clearly defined, it may be appropriate to revise the plan to include wildland fire use to achieve natural resource management objectives. If that were the case, a new Environmental Assessment or Environmental Impact Statement would be prepared in compliance with the National Environmental Policy Act of 1969 and its implementing regulations.

2.5 Alternatives Considered and Dismissed

Full Suppression and Increased Use of Mechanical and Chemical Treatments

The National area is rugged, cut by deep, steep-sided valleys, and contains bluffs, cliffs, and other related topographical features. The rugged nature of the landscape and other factors, such as the lack of roads, would make access difficult and time consuming, and would require that much of the work be completed by hand. As a result, large-scale mechanical and chemical treatment would be cost prohibitive.

3.0 AFFECTED ENVIRONMENT

3.1 Soils: The Cumberland Plateau is underlain by roughly horizontal sedimentary rock strata, which is primarily sandstone, and shale (Campbell & Newton 1995). As would be expected, most of the soils on the plateau are formed from these weathered materials. The depth of the soil to bedrock ranges from about one foot on steep hillsides to about four-to-five feet on broad, smooth interstream divides (Campbell & Newton 1995). Generally, the soils are well-drained, silty clay loam. Although low in natural fertility, plants grown on these soils generally were higher in nutritive value than plants grown on other soils and had the best potential for supporting wildlife of any in the McCreary-Whitley County, Kentucky area (Byrne, et al. 1964).

3.2 Air Quality: Air quality in the National Area receives protection under several provisions of the Clean Air Act (CAA), including the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Program. The area is considered to be in attainment of the NAAQS, the minimum standards for air quality throughout the country. The PSD Program provides additional protection from air pollution. One of the goals of the PSD Program is to preserve, protect, and enhance the air quality in areas of special natural, recreational, scenic, or historic value, including the National Area (Ross 1990). Under this program, the National Area is classified as a Class II area. Only a limited amount of additional air pollution, due to moderate growth, can be allowed in the area over time (certain national parks and wilderness areas are classified as Class I and receive the highest protection under the CAA).

Despite this protection, air quality and visibility are affected by air pollution in the area. Visibility is often reduced by fine particulate pollution, as it is throughout the East. In its 1993 report on visibility in national parks and wilderness areas, the National Research Council concluded that in most of the East, the average visual range is less than 20 miles (about 30 km), or about one-fifth of the natural range (National Research Council 1993). The visual range in the National Area is approximately 10-15 miles (17-25 km) (EPA 1998).

3.3 Hydrology: One of the primary reasons the National Area was established was to preserve as a natural, free-flowing stream, the Big South Fork of the Cumberland River for the benefit and enjoyment of present and future generations. The Big South Fork River is formed by the New River and the Clear Fork River, and drains the northern portion of the Cumberland Plateau in Tennessee. As the Big South Fork flows from south to north it is fed by a variety of sources ranging from perennial streams, such as North White Oak Creek, to many creeks that are intermittent in nature. Flooding is common during the winter months (December – March) when the soils are saturated, frozen or covered with snow. Springs and ponds can be found scattered throughout the National Area. Preserving the water quality of the Big South Fork is an important management concern for the National Area.

The aquatic environment of the Big South Fork gorge and adjacent plateau supports a wide variety of plant and animal life which depends upon the aquatic systems for drinking, food, living space and cover (Corps of Engineers 1976). The river and its floodplain are habitat for nine federally endangered or threatened species (2 floodplain plant species and 7 animal species). Therefore, due care and caution must be exercised while carrying out fire management operations to prevent impacting this special resource. A complete overview of the management of the water resources is contained in the Big South Fork NRRA Water Resources Management Plan (Hamilton & Turrini-Smith 1997) on file at the National Area Headquarters.

3.4 Vegetation: The vegetation of the National Area is very diverse as the result of soil, available moisture, aspect, and previous land use (Safley 1970, Hinkle 1989) (Figure 3). The majority of the landscape is forested. Upland communities range from red maple (*Acer rubrum*) dominated stands on poorly drained flats to Virginia pine (*Pinus virginiana*) dominated stands on dry ridges and cliff edges. Forests of mixed oaks (*Quercus spp*) with a limited hickory (*Carya spp*) element characterize the broad flats and the gentle slopes of the upland. In Tennessee, the same oaks are present, but pines are not a dominant overstory component, although White pine *(Pinus strobus*) is becoming established in some areas (personal observation). Hickories (*Carya spp*), including pignut (*C. glabra*), mockernut (*C. tomentosa*), shagbark (*C. ovata*), and bitternut (*C. cordiformis*), form a widespread but minor component.

Ravine communities are generally dominated by more mesic species with a rich oak (*Quercus spp*) element on the middle to lower slopes. Mixed Mesophytic vegetation is found on protected sites with richer soils, and is restricted to escarpment slopes, coves, and deeper ravines (Hinkle 1989). Hemlock (*Tsuga canadensis*) is prominent in narrow gorges in North facing coves and along streams (Hinkle 1989). Examples of dominant north-facing tree species in the mixed mesophytic vegetation type include oaks (*Quercus spp*), American basswood (*Tilia americana*), black birch (*Betula nigra*), magnolias (*Magnolia spp*), and tulip poplar (*Liriodendron tulipifera*). On the drier sites post oak (*Q. stellata*), southern red oak (*Q. falcata)* scarlet oak (*Q. coccinea*), and black oak (*Q. velutina*); on moister sites, white oak (*Q. alba*) and black oak (*Q. velutina*) predominate. In this zone, between the river bottoms and the moist upper reaches of the gorge, are also found sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), and tulip poplar (*Liriodendron tulipifera*).

In many locations, the gorge rises steeply from the river. The river, when in flood stage, scours the land, allowing little vegetation to take hold. On the level floodplain where floodwaters periodically inundate the vegetation but do not destroy it, a well-established forest has developed (Corps of Engineers 1976). The alluvial forest consists of river birch (*Betula nigra*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), cucumber tree (*Magnolia acuminata*), and other mesic species. In the understory, ironwood (*Carpinus caroliniana*), bigleaf magnolia (*Magnolia macrophylla*), box elder (*Acer negundo*), basswood (*Tilia americana*), and saplings of the canopy species are prominent. The ground cover is patchy. A few stands of cane (*Arundinaria gigantea*) are present (Corps of Engineers 1976).

Forests of the type found in the National Area are characterized by high biodiversity and are among the most biologically rich systems of the temperate regions of the world, certainly in the United States (Hinkle et al. 1993). An excellent overview of the vegetation present when the National Area was created, and the inter-relationships of the flora with fauna can be found in Final Environmental Impact Statement: Establishment, Administration, and Maintenance of the Big South Fork National River and Recreation Area, Tennessee and Kentucky (Corps of Engineers 1976). This document is on file at the National Area Headquarters.

A listing of selected plant species and their relationships to fire is contained in Appendix EA-C.

3.5 Wildlife: One of the guiding principles contained in the Wildland and Prescribed Fire Management Policy: Implementation and Reference Guide requires that “fire management plans must be based on the best available science”(NWCG 1998). The role wildland fire plays in the distribution and composition of wildlife species is not well known. Lyon, et al. (1978) noted that managers lack descriptions of both short-term and long-term ecosystem responses to wildland fire, including site-specific responses of food, cover, and animals, and differential response to season of burn and repeated burning. They also stated researchers lack knowledge of specific habitat requirements, life histories, and inter-species relationships of key faunal species or groups. However, Lyon concluded there is enough general knowledge available to resource managers to state that fire is beneficial to many wildlife species and the detrimental effects of fire on many animals are short lived. (Lyon, et al. 1978). Although the observations made by Lyon and his fellow researchers remains true today, several studies over the past two decades of specific species and their habitats have been undertaken. These studies are expanding the knowledge available to resource managers. In keeping with the guiding principle referenced at the beginning of this paragraph, as even more knowledge becomes available, the knowledge generated will be used to improve the fire management program.

The primary mammals of the National Area are the white-tailed deer (*Odocoileus virginianus*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Lynx rufus*), raccoon (*Procyon lotor*), mink (*Mustela vison*), stripped skunk (*M*ephitis *mephitis*), muskrat (*Ondatra zibethicus*), and eastern gray squirrel (*Sciurus carolinensis*). Some common small mammals include the smoky shrew (*Sorex fumeus*), pygmy shrew (*Sorex hoyi*), hispid cotton rat (*Sidmodon hispidus*), white-footed mouse (*Peromyscus leucopus*), and woodland (pine) vole *(Microtus pinetorum*). The little brown bat (*Myotis lucifus*) and Rafinesques’s big-eared bat (*Plecotus rafinesquii*) are present. Black bears (*Ursus americanus*) are occasionally sighted in the Big South Fork Region.

Figure 3: Vegetative Types of Big South Fork National River and Recreation Area

The National Area provides a variety of habitats for several species of birds. The wild turkey (*Meleagris gallopavo*) and ruffed grouse (*Bonasa umbellus*), both which benefit from fire (Lyon et al. 1978), are the two principal game birds that can be found in the hardwood and mixed hardwood-pine habitat type. Although there are several species of birds that inhabit the National Area, Partners In Flight (Anderson et al. 1999) have identified certain species that indicate the over-all health of the ecosystem. The cerulean warbler (*Dendroica cerulea*) and the American redstart (*Setaphaga ruticilla*) which also are found in the hardwood and mixed hardwood-pine habitat type have been identified by Partners in Flight (Anderson et al. 1999) as a species of high concern. The riparian woodlands provide habitat for the Acadian flycatcher (*Empidonax virescens*), Swainson's warbler (*Limnothlypis swainsonii*), summer tanager (*Piranga rubra*), and the ruby-throated hummingbird (*Archilochus colubris*). Birds that favor open grasslands or forest edge habitat include the field sparrow (*Spizella puscilla*), and the grasshopper sparrow (*Ammodramus savannarum*). The yellow-breasted chat (*Icteria virens*), Eastern towhee (*Pipilo erythropthalma*), and the gray catbird (*Dumetella carolinensis*) inhabit scrub-shrub vegetation that is often found on reclaimed mines. The Bewick's wren (*Thryomanes bewickii*) was identified as a species that occur in slash piles and clumps of low brush (Anderson et al. 1999). It is the contention of Partners In Flight that when these habitats disappear, so will the species (Anderson et al. 1999). Fire can be a useful tool in the management or maintenance of each of these habitat types.

Reptiles, like other species, require a variety of sites, ranging from xeric to very moist. Research on the influence of fires on reptiles and amphibians is poorly documented. Reptiles present include the northern copperhead (*Agkistrodon contortrix*), eastern garter snake (*Thamnopus sirtalis*), northern ringneck snake (*Diadophis punctatus*), black rat snake (*Elaphe obsoleta*), five-lined skink (*Eumeces fascianatus*), and eastern box turtle (*Terrapene carolina*). Common amphibian species are the green salamander (*Aneides aeneus*), Northern spring salamander (*Gyrinophilus porphyriticus*), Black Mountain dusky salamander (*Desmognathus welteri*), seal salamander (*Desmognathus monticola*), slimy salamander (*Plethodon glutinosus*), spotted salamander (*Ambystoma maculatum*), American toad (*Bufo americanus*), mountain chorus frog (*Pseudacris brachyphona*), green frog (*Rana clamitans*), pickerel frog (*Rana palustris*), and wood frog (*Rana sylvatica*) (Hamilton and Turrini-Smith 1997).

Comiskey and Etnier (1972) confirmed the presence of 67 species of fishes in Big South Fork of the Cumberland River and its tributaries. Fish species range from the rainbow trout (*Salmo gairdneri*) an introduced species, to the duskytail darter (*Etheostoma percnurum*), a federally-listed species. The National Area supports 25 documented species of freshwater mussels, five of which are federally endangered. In the southeast only the Clinch and Green Rivers contain this level of diversity, and only two other National Park Service units in the country have greater diversity (NPS 2000). A number of state and federally listed aquatic species are found in the National Area (See following section).

A listing of selected wildlife species and their relationships to fire can be found in Appendix EA-D.

3.6 Threatened and Endangered Species: Federally and state-listed endangered, threatened, and rare flora and fauna have been inventoried by the state Natural Heritage Programs (1997), and by law and NPS policy require special consideration and protection. The stretch of the Big South Fork from Leatherwood Ford to Bear Creek is noteworthy because its water quality and streambed characteristics combine to provide important habitat for federally listed plant and animal species (NPS 2000). Five federally endangered freshwater mussels and a federally endangered fish species occur in the Big South Fork and its major tributaries.

Three federally listed plant species occur in the National Area: Cumberland sandwort (*Arenaria cumberlandensis*), Cumberland rosemary (*Conradina verticillata*), and Virginia spiraea (*Spiraea virginiana*). There are historic records of green pitcher plant (*Sarracenia oreophila*) and the American chaffseed (*Schwalbea americana*) within the Big South Fork region. In addition to the federally-listed species, fifty-one state-listed threatened or endangered plants occur in the National Area.

The National Area is located in the northern range of the federally listed red-cockaded woodpecker *(Picoides borealis*), a fire adapted species. Two active colonies were located in the vicinity of the National Area before the southern pine beetle outbreak of 1999 (USDA Forest Service personal communication). The river otter (*Lutra canadensis*), which was re-introduced in the National Area, is a state-listed threatened mammal.

The effect of wildland fire on the rare and endangered flora and fauna is not fully known. Empirical data on rare species' responses to fire are generally lacking and this holds true for most of the rare, threatened, and endangered flora and fauna that occur in the National Area. The available literature describing expected fire effects on Cumberland Plateau rare species presents mostly anecdotal evidence or authors' best estimates (e.g., Pyne and Shea 1994, Campbell 2001). Such statements of expected fire effects are often generalized and conditional; managers must recognize that a population's actual response at a given time and site may differ from the predicted response for that species. Fire characteristics, vegetation type, site conditions, and post-fire weather are among the determinants of population response to individual fires (Brown and Smith 2000).

In contrast to the low state of knowledge of rare species' response to fire, we understand more clearly the role of fire for communities or vegetation cover types in the National Area. The role of fire in the Eastern United States is well documented (e.g., Brown and Smith 2000) and a recent study has expounded on fire's historical role and potential effects at Big South Fork NRRA (Campbell 2001). By writing fire prescriptions that are consistent with known fire regimes for vegetation types that occur in the National Area, we are less likely to adversely impact rare flora and fauna. We know for example, that the mixed-mesophytic forest typical of the National Area's river gorge and ravines is subject to a mixed fire regime, probably at a frequency > 200 yrs (Brown and Smith 2000). We can reasonably assume that the rare species that inhabit this forest type would not benefit from a high-frequency fire regime that might be prescribed for an oak-pine vegetation type.

In addition to species' habitat association, we can also glean clues about a species' relationship to fire by examining its morphology, regeneration strategy, and other life history attributes. Many plant species, in particular, have adapted certain morphological structures, physiological characteristics, and regeneration strategies that allow individuals to survive fire or populations to recover from fire.

Lastly, species- and population-specific monitoring following prescribed burning in the National Area will contribute to the body of fire-effects knowledge and help us fine-tune our fire management prescriptions to avoid impacts to rare species. By treating fire management as an adaptive process, we can judiciously use fire to achieve both hazard fuel reduction and species conservation goals.

A complete listing of federally and state listed threatened and endangered species that may occur in the National Area can be found in Appendix EA-E. For additional discussion of the potential impacts of the proposed actions on T&E species and the suggested measures to mitigate those impacts, see the attached Biological Assessment of the Fire Management Plan.

3.7 Cultural Resources: When the National Area was created, numerous cultural sites were acquired within the legislative boundary. These sites include settlements, mining sites and towns, logging sites, prehistoric and historic archeological sites, and farmsteads with associated agricultural fields. Currently (January 2000), five sites and 15 structures have been determined to meet criteria for listing on the National Register of Historic Places. Cultural landscapes in the National Area include farmsteads, cemeteries, openings for sawmill sites, and coal mines. A large number of old farm fields in the National Area are remnants of the agricultural lifestyle of the inhabitants of the upper Cumberland Plateau. Some of these fields have been preserved as cultural landscapes. Numerous (over 2,000) archeological sites, ranging from lithic scatters to rockshelters, document human activity from several hundred to over 11,000 years ago.

The goal for this Fire Management Plan is to produce and maintain landscape configurations that existed at cultural landscapes during the periods of historic significance. On the basis of research and investigations conducted at Big South Fork (Des Jean 1994, 2001; Ferguson et Al. 1986; Prentice 1992, 1993b, 1993c, 1995, 1999; Wilson and Finch 1980). None of the 15 previously disturbed agricultural fields selected to be included in this Fire Management Plan (Table 13, pp60) contain archeological resources that will be affected by the proposed actions. Exceptions to this could occur if large trees and other vegetation were allowed to grow up adjacent to historic structures located in these historic fields. Such vegetation would have to be removed mechanically thus presenting a danger to associated historic archeological deposits and the structures themselves. Controlling for this type of impact is described under the various alternatives for the proposed actions.

Various protection strategies will be developed by an interdisceplinary fire planning team for the different cultural landscapes at Big South Fork. Different techniques will be used to preserve the historic orchards, fences, cattle pens, and plants at each cultural landscape. Following the burns, the effetiveness of fire management efforts will be evaluated by the Cultural Resources Specialist and the team to evaluate cultural feature preservation efforts and the goal of reestablishing historic site configuration.

A complete listing of cultural resources is on file at National Area Headquarters.

3.8 Visitor Use

The National Area draws approximately 900,000 visitors to the area annually (NPS 2000). As a result, recreation is expected to play an ever-increasing role in the local economy. The primary recreational pursuits are hunting, horseback riding, rafting, canoeing, camping, hiking, sightseeing, and related activities. School groups come to the area to study the environment. The nearby land is being subdivided into second-home developments, increasing the amount of area included within the wildland urban interface adjacent to the National Area.

3.9 Sacred Sites and Indian Trust Resources: Although there has been occupation by Native Americans in the area for thousands of years, past studies at the National Area have failed to identify any sites here that would be considered “Sacred” by Native Americans. The majority of the sites associated with Native Maericans here have been determined to be prehsitoric sites of temporary seasonal occupation. Many of the sites were located on ridge tops and intersections of ridges that , unfortunately, have been heavily impacted by road construction since the logging era began.

4.0 ENVIRONMENTAL CONSEQUENCES

Methodology for Assessing Impacts

Potential impacts are described in terms of type (are the effects beneficial or adverse?), context (are the effects site-specific, local, or even regional?), duration (are the effects short-term, lasting less than one year, or long-term, lasting more than one year?), and intensity (are the effects negligible, minor, moderate, or major?). Because definitions of intensity (negligible, minor, moderate, or major) vary by impact topic, intensity definitions are provided separately for each impact topic analyzed in this environmental assessment/assessment of effect.

In addition, National Park Service's *Management Policies, 2001* require analysis of potential effects to determine whether or not actions would impair park resources. The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adversely impacting park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within park, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values. An impact to any park resource or value may constitute impairment, but an impact would be more likely to constitute an impairment to the extent that it has a major or severe adverse effect upon a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessionaires, contractors, and others operating in the park. A determination on impairment is made in the *Environmental Consequences* section for each impact topic.

Cumulative Impacts

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act of 1969 (42 USC 4321 *et seq*.), require assessment of cumulative impacts in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all of the alternatives.

Cumulative impacts were determined by combining the impacts of Alternatives with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at the park.

<u>Private Development Around Big South Fork NRRA</u>
Property development outside the park is likely. Tracts just outside the park are currently being subdivided and developed with homes. As Big South Fork NRRA becomes a more popular tourist destination, subdivision and property development become more and more prolific and the wildland-urban interface becomes more of a safety concern.

<u>Consumptive Uses Outside the Park</u>
Mining and minerals exploration are likely because the area is known to contain both coal and oil and gas resources. The Tennessee Valley Authority has begun planning for a substantial amount of coal extraction (approximately 70 million tons) in the Royal Blue Wildlife Management Area, which is in the watershed of the Big South Fork.

<u>Prescribed Fire Efforts of the Daniel Boone National Forest</u>
The Daniel Boone National Forest is currently increasing their use of prescribed fire to achieve resource objectives.

<u>4.1 Soils</u>

<u>Methodology and Intensity Thresholds</u>
Analyses of the potential intensity of impacts to soils were derived from available soils information (NRCS), park staff's observations of the effects on soils from fire, and literature on fire ecology and effects. The thresholds of change for the intensity of impacts to soils are defined as follows:

Negligible: The impact is at the lowest levels of detection and causes very little or no physical disturbance /removal, compaction, unnatural erosion, when compared with current conditions.

Minor: The impact is slight but detectable in some areas, with few perceptible effects of physical disturbance/removal, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil nutrients in small, localized areas.

Moderate: The impact is readily apparent in some areas and has measurable effects of physical disturbance/removal, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil nutrients in several large areas.

Major: The impact is readily apparent in several areas and has severe effects of physical disturbance/removal, compaction, or unnatural erosion of soils. Beneficial effects include measurable increases in soil nutrients in a substantial portion of the park.

Short Term Impacts: Under all three alternatives, a portion of the organic nitrogen on site would be volatilized as the result of fire use activities. However, larger amounts of mineralized nitrogen would become available on a short-term basis for plant uptake due to fire-caused mineralization of organic nitrogen and increased nitrogen fixation associated with microsite changes caused by fire use (Wade 1989, EPA 1999). When a fire changes a log or other woody material to ash, nutrients bound in chemical compounds are released and changed to a form that is more water-soluble. In this soluble form, nutrients percolating into the soil are again usable in the growth of other plants (USDA Forest Service 1993).

Under normal circumstances, sufficient moisture would be present to prevent complete combustion of the duff and forest litter, providing a protective layer for the soil (Wade 1989). Soil erosion caused by wildland fire suppression activities would in all likelihood be confined to fireline constructed on steep slopes (slopes 25% or greater).

Removal of vegetation and the underlying forest floor (duff) by fire decreases the amount of rainfall that is absorbed by the soil, thereby increasing the potential for runoff (Tiedemann 1979). Erosional responses to burning are a function of several factors such as the degree of elimination of protective cover, steepness of slope, degree the affected soil sheds water, climatic characteristics, and how quickly the vegetation recovers (Tidemann 1979, Wade 1989). Few studies have been conducted in the eastern United States to assess fire effects on the soils. However, conventional wisdom has shown if the prescribed burn or wildland fire is under a timber stand and some duff remains, soil movement will be minor on slopes up to 25 percent (Wade 1989).

Should piled or windrowed debris or forest litter happen to burn when fuel and/or soil moisture conditions are extremely low, soil temperatures may be elevated long enough to ignite organic matter in the soil and alter the structure of soil clays (Wade 1989). This event is more likely to occur under Alternative A because of the gradual buildup of fuels.

Prescribed burning as proposed in Alternative B would free nutrients and normally would cause little or no detectable change in the amount of organic matter in surface soils. In fact, slight increases in organic matter have been reported on some burned areas (Wade 1989). Low intensity surface fires under a timber overstory conducted under prescriptive parameters would not cause changes in the structure of mineral soil because the elevated temperatures are of brief duration and the burns would be conducted under controlled conditions.

In addition to the impacts noted under Alternative B, less fireline would be constructed under Alternative C. This would reduce the likelihood of soil erosion resulting from soil disturbance.

Long Term Impacts: Alternatives B and C would accelerate the natural decomposition process and increase nitrogen available to stimulate growth and restore surface herbaceous vegetation, perpetuating organic soil layers and increasing site productivity.

As the result of fire exclusion, park-wide soil productivity would decline slightly under Alternative A, as some nutrients become organically bound primarily in woody species biomass (As a stand matures, as it would under a limited fire regime, an increasing portion of the nutrients on the site become locked up in the vegetation and would be unavailable for further use until the plants die and decompose). When heavy concentrations of fuel burn during periods of high temperature and low fuel moistures, the heat per unit area may be elevated long enough to ignite organic matter in the soils and render the soils fallow for several years. If the forest floor is completely consumed, which is more likely under Alternative A, the microenvironment of the upper soil layer would be drastically changed, perhaps even resulting in increased tree mortality (Wade 1989). Mineral soils that are repeatedly exposed or exposed for long periods of time can experience decreasing infiltration rates and aeration of the soil as rain clogs fine pores with soil and carbon particles (Wade 1989). These factors could lead to increased soil erosion, reduced soil productivity, and decreased ground water recharge rates.

Soils would be better protected from the adverse effects of high-intensity fires through the fuel management techniques proposed in Alternative B. The low-intensity prescribed fires proposed in this alternative would speed up the nutrient recycling process, returning nutrients back to the soil where they would be available to stimulate plant growth and vigor. Prescribed fires would be conducted under predetermined conditions that would insure that the protective layer was not removed, exposing mineral soil to the effects of erosion.

The long-term benefits described for Alternative B would the same for Alternative C.

Cumulative Impacts: The Daniel Boone National Forest is increasing their use of prescribed fire. Their efforts, combined with Alternative B or C could have a cumulative net benefit to soils on the Cumberland Plateau.

Methods to Reduce Impacts: Prescriptions designed to reduce fire severity during prescribed fire operations would be followed. Existing roads and trails would be used to the greatest extent possible as control lines for both wildland and prescribed fires. Tactics involving the use of leaf blowers and handtools that do not result in soil disturbance would be employed to construct firelines, where appropriate. Fire management personnel would rehabilitate firelines after the fire management operation is completed to reduce or eliminate soil loss through erosion.

Conclusion:

- <u>Alternative A</u> may lead to soil degradation as a result of increased likelihood of large-scale, high intensity wildland fires as fuel accumulations remain high. Soils impacts from Alternative A would be adverse and moderate. Impacts from Alternative A, however, would not result in an impairment to park resources.
- <u>Alternative B</u> would protect soil resources in the long-term by increasing available nutrients, reducing soil disturbance and reducing the adverse effects resulting from high intensity wildland fires. Soils impacts from Alternative B would be beneficial and moderate. Impacts of Alternative B would not result in an impairment of park resources.
- Like Alternative B, <u>Alternative C</u> would protect soil resources in the long-term by increasing available nutrients, reducing soil disturbance and reducing the adverse effects resulting from high intensity wildland fires. Soils impacts from Alternative C would likely be beneficial and moderate, but prescribed fire on the Cumberland Plateau is not understood well enough to make a definitive conclusion at this time. Impacts from Alternative C would not result in an impairment of park resources.

<u>4.2 Air Quality</u>

<u>Methodology and Intensity Thresholds</u>
Analyses of the potential intensity of impacts to air quality were derived from Environmental Protection Agency (EPA) standards and smoke management guidelines of the National Wildfire Coordination Group (NWCG). The thresholds of change for the intensity of impacts to air quality are defined as follows:

Negligible:	Impacts are not detectable, well below air quality standards, and within historical baseline air quality conditions.
Minor:	Impacts are detectable but well within or below air quality standards and within historical baseline air quality conditions.
Moderate:	Impacts are detectable, within or below air quality standards, but historical baseline air quality conditions are being altered on a short-term basis.
Major:	Impacts are detectable and persistently alter historical baseline air quality conditions. Air quality standards are locally approached, equaled, or exceeded.

Short Term Impacts: Under all three alternatives, wildland fires within the National Area would continue to have adverse impacts to air quality. Based on fire statistics from the past ten years (1992 through 2001), a typical wildland fire burns less than 203 acres

(Shared Application Computer System 2001). The emissions from a fire of this size would primarily affect only the area adjacent to the scene of the fire for a short time, generally one to two days, depending on the size of the fire, the fuels, and the environmental conditions present. Visibility could be reduced for short periods of time in areas within the river gorge and adjacent to the National Area. Human health standards (National Ambient Air Quality Standards for particulate matter size class of 10 microns in diameter and smaller and particulate matter of 2.5 microns in diameter and smaller) could be approached for short periods in the area immediately adjacent to the fire. Air quality on a regional scale would be affected only when many acres are burned on the same day (NWCG 1985).

Alternative A would have the least short-term impact on air quality of the three alternatives because prescribed fire would not be used and all wildland fires would be suppressed, often within the first burning period.

Alternative B would have a greater short-term impact on air quality due to the prescribed fire activity. When using prescribed fires on areas with light fuel loadings such as grasslands or frequently burned pine stands, total smoke production would be low because smoldering combustion is minimal in these fuel types (NWCG 1985). Maximum standards for public health outside the immediate vicinity of the fire would not be exceeded due to management actions and prescriptive parameters. Fires that were no longer in prescription would be extinguished.

Alternative C would have the potential to have the greatest over-all short-term impact on air quality due to the provision that allows for the use of wildland fire to achieve management objectives. Fires burning under this provision may burn for several days under the right set of conditions. Techniques available to managers conducting prescribed burns, such as pre-treating fuels to reduce fuel loading or varying ignition patterns, often cannot be used to reduce emissions from naturally ignited fires (EPA 1998). However, wildland fire use operations would be conducted following predetermined prescriptions, including favorable conditions that would limit the impacts of smoke.

Long Term Impacts: A common goal of all wildland owners/managers is to minimize the potential for catastrophic wildfires that could result from heavy accumulations of vegetative fuels (EPA 1998). Woody material that decomposes through the decay process often can smolder for long periods of time, increasing the amount of particulates emitted. Fires that occur in areas with heavy accumulations of fuel can have the most adverse impact on air quality. The absence of fire and the limited use of other fuel management techniques would result in heavy accumulations of fuels that would be difficult to suppress and would lead to larger fires of longer duration. Fires of this type would be expected to impact air quality for extended periods of time. Both human health and visual standards would likely be exceeded for longer periods of time in the vicinity of the fire.

Under Alternative B, the potential for long duration air quality concerns would be reduced because the likelihood of large wildland fires occurring would be reduced through proactive fuels management. Because prescribed burns can be scheduled, Alternative B would provide the greatest flexibility in taking advantage of favorable conditions to coordinate with other regional smoke producers to disperse smoke and avoid impacting sensitive areas. This would allow the distribution of emissions over time and space to avoid exceeding air quality standards.

Alternative C would reduce most quickly the potential for large, high intensity, long duration wildland fires that could impact air quality. Alternative C would also reduce potential smoke impacts from high intensity wildfires by conducting prescribed burns and by adding an additional tool, the management of natural ignitions occurring under favorable conditions. Allowing lightning-ignited wildland fires to burn under favorable environmental conditions would reduce accumulations of fuels that could lead to catastrophic fires. However, the number of lightning caused ignitions is so small and the conditions under which they burn are such that little advantage can be expected.

Cumulative Impacts: As adjacent lands are developed and visitation to the National Forest and National Area increases, there is an increased risk of human caused ignitions. When coupled with increasing fuel loads that would be present under Alternative A, more frequent, large wildland fires could occur across agency boundaries, resulting in increased emissions, reduced air quality, and increased health risks.

Regional air quality during prescribed fire operations can be affected by meteorology; existing air quality; the size, timing, and duration of the activity; and other activities occurring in the same airshed when many acres are burned on the same day. Alternatives B and C would provide flexibility to schedule burns and to coordinate with other regional smoke producers to take advantage of favorable conditions that are required to disperse smoke and avoid regional cumulative smoke impacts.

Methods to Reduce Impacts: The Environmental Protection Agency (EPA) recognizes that wildland fires of all kinds (wildfire, prescribed fires, etc.) contribute to regional haze, and there is a complex relationship between what is considered a natural source of fire versus a human-caused source of fire. For example, the increased use of prescribed fire in some areas may lead to particulate emissions levels lower than those that would be expected from a catastrophic wildfire. Given that in many instances the purpose of prescribed fire is to restore the natural fire cycles to the forest ecosystems, EPA will work with state and federal land managers to support development of enhanced smoke management plans to minimize the effects of emissions on public health and welfare (EPA 1999).

Several methods are available to reduce the impacts to air quality including, (1) minimizing the area burned, (2) reducing the fuel loading in the area to be burned through mechanical pretreatment, (3) reducing the amount of fuel consumed by fire through the use of smaller units, and (4) minimizing emissions per ton of fuel consumed by burning under favorable conditions or using different firing techniques. Another action that can be taken to minimize fire emission includes rapid and complete mop-up of fuels known to contribute to poor air quality or impact human health.

Secondary emissions are pollutants formed in the atmosphere by photochemical transformation of primary emissions. They include oxidants such as ozone that is a criteria pollutant as defined by the EPA. The specific emission factors for secondary emissions from prescribed burning are unknown but are believed to be relatively small (Haddow 1989). For ozone to form, nitrogen oxide (Nox) is required as well as volatile organic compounds (VOCs) emissions in the presence of sunlight. The amount of Nox and VOCs generated would be dependent on the types of fuel burned, the moisture content, and the temperature of the combustion process (Carson, personal communication). Currently, readings taken at all air monitoring stations nearest the National Area are meeting the National Ambient Air Quality Standards for ozone and PM10 (EPA website). Prescribed burns would not be conducted under conditions favorable to the formation of ozone.

Prescriptive elements in prescribed burn plans would specify the proper conditions necessary to increase smoke dispersal and enhance burning, thereby reducing impacts from smoke.

Under the Clean Air Act, the Service is responsible for protecting air quality within park boundaries, and to take appropriate action to do so, when reviewing emission sources both within and in proximity to parks (Malkin 1994, Clean Air Act, as amended). Therefore, all prescribed burns would be conducted in accordance with regulations established by the Commonwealth of Kentucky, the State of Tennessee and the Clean Air Act.

Conclusion:

- The adverse air quality impacts associated with Alternative A, in the short term, would be negligible. In the long term, there would be the potential for high intensity, long duration fires resulting from excessive fuel loading. Therefore, adverse long-term impacts would be moderate. No impairment would result from the implementation of alternative A.
- In the short term, Alternative B would include more fires and more smoke impacts than Alternative A. Adverse short-term impacts from Alternative B would be minor. In the long term, Alternative B would result in fewer high intensity, long duration fires, so adverse impacts would be minor. No impairment to park resources would result from Alternative B.
- Adverse air quality impacts from Alternative C would be similar to those of Alternative B. There would be no impairment to park resources.

4.3 Water Quality

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to water quality were derived from park staff's observations of the effects of fire on water quality and from literature on fire ecology and effects. The thresholds of change for the intensity of impacts to water quality are defined as follows:

Negligible:	Impacts are not detectable, well below water quality standards, and within historical baseline water quality conditions.
Minor:	Impacts are detectable but well within or below water quality standards and within historical baseline water quality conditions.
Moderate:	Impacts are detectable, within or below water quality standards, but historical baseline water quality conditions are being altered on a short-term basis.
Major:	Impacts are detectable and persistently alter historical baseline water quality conditions. Water quality standards are locally approached, equaled, or exceeded.

Water quality is of great concern at Big South Fork NRRA because of populations of five federally listed endangered mussels and one fish that exist in the main stem of the river and some of the major tributaries. Water quality must be protected and enhanced to the maximum extend possible.

Short Term Impacts: Large fires occurring on steep, south-facing slopes where conditions are drier might contribute to increased run-off of rainfall as a result of total consumption of the leaf litter and protective duff. Firelines constructed on slopes greater than 25 percent may also have the same result on a much smaller scale. When surface runoff increases after a fire, the run-off may carry suspended soil particles, dissolved inorganic nutrients, and other materials into adjacent streams impacting water quality (Wade1989).

Prescribed fire operations, especially those involving line constructions on steep slopes, may have the same impact on water quality as those described under suppression operations. However, depending on the objectives identified for the area, both prescribed burns and wildland fire to achieve resource management benefit would use existing man made and natural barriers. They would be conducted under conditions that would ensure that sufficient residual duff was retained to prevent soil erosion and the resulting impact to water quality.

Fire suppressant chemicals, when applied directly to waterways, have been demonstrated to adversely affect aquatic organisms (McDonald et al. 1995a, McDonald et al. 1995b, Minshall 2003, Minshall and Brock 1991, Norris and Webb 1989, Poulton 1996). Runoff from applications adjacent to aquatic habitat may also cause mortality in aquatic organisms (Norris and Webb 1989). Two types of chemical fire suppressant formulations are commonly applied: 1) fire suppressant foams and 2) fire retardants.

Suppressant foams are wetting agents composed of solvents, surfactants, inhibiting agents, and foam stabilizing agents. Several tested foams are moderately toxic to fish, presumably due to reduced surface tension from surfactant components (e.g., Gaikowski et al. 1996). Two commonly used foams, Silv-Ex and Phoschek WD881, also caused mortality or impaired movement of water boatmen (*Cenocorixa* sp.) in field trials (Poulton 1996). In addition to being acutely toxic, surfactants may also alter biological membrane permeability, affecting uptake of pollutants or essential nutrients (Gaikowski et al. 1996).

Fire retardants are usually composed of ammonium polyphosphate, ammonium sulfate, monoammonium phosphate, or diammonium phosphate. Inactive ingredients may include clay particles to maintain suspension and guar-gum derivatives for thickening. In contrast to suppressant foams, two commonly used fire retardants, Fire-Trol GTS-R and PC D75-F, exhibited low toxicity to fathead minnow (*Pimephales promelas*) in laboratory trials (Gaikowski et al. 1996). These results are consistent with other laboratory or field trials that indicate foams pose a greater risk than retardants to aquatic organisms when directly applied to water.

Long Term Impacts: The continued elimination of wildland fire from the ecosystem as proposed under Alternative A may slightly reduce ground water yields to streams feeding the Big South Fork, but the effect would be negligible due to the nature of mixed hardwood - pine forests (Tiedemann 1979). Under this alternative, the possibility of larger, more intense wildland fires can be expected. Higher intensity wildfires occurring during dry periods could result in the loss of protective ground cover. The resulting loss of protective duff layers would increase the likelihood of sedimentation and increased water turbidity, the most dramatic and important water quality responses associated with fire (Tiedemann 1978).

Under Alternative B, using a combination of mechanical treatments and prescribed fire, the park staff would selectively treat areas prone to high intensity fires under controlled conditions. The proactive nature of this alternative would reduce the likelihood of large, high intensity fires that appear to have the greatest potential for causing damage to water resources (Tiedemann 1979). This alternative provides an effective means of insuring that protective ground cover would be retained and the soil's moisture absorbing qualities would be protected over the long term. By protecting the ground cover, the potential for large amounts of sediments reaching watercourses would be greatly reduced, and the ground water reserves would be recharged.

Long-term impacts associated with currently available retardant and foam formulations is believed to be low because of the transient nature of the chemical plume in streams and biodegradation of major toxic components in the chemicals (Buhl 2000, Norris and Webb 1989). Additionally, adsorption and binding of surfactants to solids and dissolved organic matter likely reduces the bioavailability of anionic surfactants (Buhl 2000).

Similar results listed for Alternative B would be expected for Alternative C.

Cumulative Impacts: A mixture of land development, strip mining, timber harvesting, prescribed burning, and large, intense wildland fires (most likely associated with Alternative A) in a common drainage could increase the possibility of sedimentation in a particular watershed. This could result in major, adverse cumulative impacts to water quality.

Methods to reduce impacts: In addition to the measures identified in the soils section, whenever possible, vegetation would be protected adjacent to streams and other water courses. The vegetation should sufficiently slow the flow of any run-off to permit debris and soil to be deposited before it could reach a stream or river. Site specific mitigation measures would be included in prescribed burn plans when appropriate. Activities would be coordinated with neighboring landowners and agencies to avoid impacting a specific watershed.

Chemical fire retardants and suppressant foams will not be used within 300 feet of any waterway. In addition, aerial fire retardants will be used only when loss of life or significant developments are imminent. Despite these stipulations, there is a possibility that retardant or foam could interface with tributary streams during fire suppression. Therefore, NPS has outlined mitigation measures that should be taken in the event of accidental fire chemical inputs to streams that support T&E species (see Biological Assessment for the Fire Management Plan).

Conclusion:

- Alternative A. Due to the possibility of erosion from high intensity wildfires, plus the possible need for chemical retardant to control these high intensity wildfires, adverse water quality impacts could occur but would be moderate. Given compliance with the listed mitigation measures, no impairment to park resources would result from implementing Alternative A.
- Under Alternative B, there would be a reduced occurrence of high intensity fires, better protection of ground vegetation, and less likelihood of soil erosion. In addition, the need for chemical retardant would be less than that of Alternative A. Given compliance with the listed mitigation measures, adverse water quality impacts from this alternative would be minor to moderate. No impairment would occur.
- The adverse impacts from implementing Alternative C would be similar to those of Alternative B, but prescribed fires provide managers a level of control and a higher degree of confidence that water resources will not be adversely impacted. Impacts from Alternative C would not result in impairment to park resources.

4.4 Vegetation

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to vegetation were derived from park staff's observations of the effects of fire on vegetation and from literature on fire ecology and vegetation effects. The thresholds of change for the intensity of impacts to vegetation are defined as follows. Impacts can be beneficial or adverse:

Negligible: Impacts occur, but are not conspicuous except for superficial consumption of surface litter. Effects on individual plants, plant populations, or functional processes are not observable. Disturbance does not result in changes to plant community structure or composition.

Minor: Impacts are detectable, but not apparent. Forest floor is lightly consumed, but not so severely as to expose mineral soil. Damage to individual plants is restricted to herbs and small shrubs and does not affect below-ground plant structures. Changes in community structure and composition are restricted to the herbaceous and low-shrub layer. Post-disturbance plant communities quickly return to pre-disturbance conditions.

Moderate: Impacts are apparent. Forest floor is partially consumed, exposing mineral soil in dispersed infrequent patches. Damage to above-ground structures is extensive for herbs, shrubs, saplings, and some fire-intolerant trees. Significant changes in plant community structure and composition occur in the understory and midstory. Post-disturbance plant communities retain many characteristics of pre-disturbance communities, but differences persist for several years.

Major: Impacts are obvious without close inspection. A majority of the forest floor and vegetation is severely impacted. Forest floor, herbs, shrubs, saplings, midstory trees, and some overstory trees are consumed. Plant damage extends to below-ground structures (e.g., roots). Changes in community structure include all vegetation strata. Changes in species composition are dramatic because of species loss and invasion of new species. Post-disturbance plant communities may not resemble pre-disturbance communities even after several years or decades.

Short Term Impacts:
Fire may injure or kill part of a plant or the entire plant, depending on how intensely the fire burns and how long the plant is exposed to high temperatures (Wade 1989). Plants that are not fire adapted are more susceptible to damage from fire. Small trees of any species suffer a higher rate of mortality. Under all three alternatives, the top-killing of small trees and shrubs within a burn area would continue to occur. Initially, under Alternatives B and C, accumulations of fuel may actually increase during the restoration phase due to the top-killing of smaller trees and shrubs by prescribed fire and debris resulting from mechanical fuel reduction operations. Alternative A would have the least impact in this regard. Due to the increased wildland fire activity, Alternative C would

have the greatest short-term effect. All alternatives may lead to the establishment of exotic plant species in highly disturbed areas and forested areas, and fire scars may make certain tree species susceptible to disease (Wade 1989).

Long Term Impacts:
Fire has been instrumental in shaping plant communities in the southern Appalachians. In particular, stands of southern yellow pine on xeric ridges and south- and west-facing slopes have historically been established and maintained by periodic fire (Van Lear and Waldrop 1989, Vose et al. 1999). The long-term absence of fire will favor more shade-tolerant, less fire-tolerant species, and succession will proceed toward a climax community rather than a fire-maintained sub-climax type (Van Lear 1989, Olson 1998). For example, xeric Virginia pine (*Pinus virginiana*) sites will be succeeded by hardwoods if fire is not introduced to the system at an appropriate frequency. On the Cumberland Plateau, current increases in red maple (*Acer rubrum*) and eastern white pine (*Pinus strobus*) density in ridge-top communities suggests a shift in species composition from fire-adapted species to species adapted to longer fire-free intervals (Blankenship and Arthur 1999). A recent epidemic of southern pine beetle (*Dendroctonous frontalis*) has accelerated the loss of Virginia pine on xeric and old-field sites on the Cumberland Plateau. Reestablishment and continued maintenance of Virginia pine on affected sites will be largely dependent on the reintroduction of fire. Under Alternative A, the lack of fire in the ecosystem would continue the successional trend away from fire-adapted species to a forest of fire-intolerant species. Subsequent large scale, high-intensity wildfire could result in a higher rate of mortality. Prescribed fire as proposed under Alternative B could be introduced to appropriate community types to reverse this trend. Similar benefits would be achieved under Alternative C.

In the absence of wildland fire, and the increase of shade-tolerant underbrush, eastern white pine and the maturing of volatile fuels such as mountain laurel would increase ladder fuels that contribute to stand replacing fires (Van Lear and Waldrop 1989). However, with the judicious use of prescribed fire and mechanical means as proposed under Alternative B, the understory could be managed to reduce ladder fuels and limit competition with desired species (which should be defined in the development of an ecological basis for future fire management). As stands of pine grow older, they are more vulnerable to insects and diseases (Buckner and Turrill, date unknown). Dense stands are also likely to become vulnerable. Insect infestations would increase and the stressed pine would be less able to resist the attacks. Another problem that is expected to soon impact red oaks is oak wilt caused by the oak wilt fungus (*Ceratocysitis fagacearum*). The disease is spread by the nitidulid beetle or through root bridging. The spores carried by the beetle may be killed by burning (Johnson and Appel 2000). If left untreated, the resulting die-off of the pine and oak by disease or insect infestation would increase the already heavy concentrations of fuel in these stands. Similar benefits would be achieved under Alternative C.

Under Alternative A, fields and other important cultural landscapes would also be lost as they are invaded by trees and other woody species, unless costly mechanical and other means were used to maintain the landscape. Non-native shrubs, such as multiflora rose

(*Rosa multiflora*) would alter the structure of fields and reduce the appeal to some preferred wildlife species. Non-native cool season grasses would continue to exclude native grasses, also reducing benefits to wildlife. In the absence of recurrent fires, barrens and remnant grasslands could be replaced by closed forests within 20 to 40 years. Attempts to reestablish warm season grasses to the historic fields and pasturelands would be severely impacted because prescribed fire, the preferred and cost-effective means of aiding in the establishment and maintenance of such stands, would not be available.

Under Alternative B, desired species such as warm season grasses would be stimulated, thereby promoting and possibly allowing them to outcompete non-native cool season grasses. The reduction of heavy fuel adjacent to homes and other structures, public use facilities, and oil and gas sites would make fires easier to manage and control. Van Lear and Waldrop (1989) observed that the role of prescribed fire in reducing the hazards of disastrous wildfires was realized after major fires in the South during the droughty 1930s and 1950s. Alternatives B and C would reverse the trend perpetuated by full suppression by opening the forest floor, protecting the overstory, and favoring fire-adapted species. Prescribed fire has also been successfully used under very exacting fuel and weather conditions to control cone insects such as the white pine cone beetle (*Conophthorus coniperda*) while the pest is over-wintering in cones on the ground (Wade 1989). Prescribed fire would tend to promote a more natural forest composition and structure, increasing tree vigor and spacing to combat pine beetle infestations. Prescribed burning generally costs much less than traditional chemical methods used to control forest pests.

Cumulative Impacts: The prescribed burning program which is currently being implemented in the Daniel Boone National Forest would interact with Alternatives B and C to create a positive cumulative benefit to vegetation in the region. Landscape level habitat diversity would be maintained or increased. The possibility of a large, catastrophic fire under Alternative A, combined with mining and logging in the region, could have a major adverse cumulative impact to vegetation.

Methods to reduce impacts: Prescribed burning has direct and indirect effects on the environment. Proper use of prescribed fire and evaluation of the benefits and costs of a burn require knowledge of how fire affects vegetation (Wade 1989). Prescribed burns will be implemented with appropriate consideration given to the historical role of fire and the potential impacts of its reintroduction to a given community. The intensity and frequency of fire in a given community will be precisely controlled to meet resource objectives. The timing of prescribed burns will be driven by a desire to realize maximum benefit to a target species or community while minimizing adverse environmental effects.

Conclusion:

- <u>Alternative A</u>. Although fire ecology on the Cumberland Plateau is not completely understood, fire does play a role in natural ecosystems, and there are fire-adapted and fire-dependent plants and plant communities (Campbell 2001). Campbell (2001) notes that a majority of the rare plants that occur in or near the National Area would potentially benefit from fire, particularly in upland habitats. In contrast, there are relatively few rare plants that occur in the mixed mesophytic forests in the river gorge and ravines, where the historical role of fire has been minor. Alternative A would exclude the processes that generate and maintain fire-adapted plants and upland communities. Loss of these communities would result in diminished habitat diversity at a landscape level. This would be a major adverse impact, but would likely not constitute an impairment of the park's vegetation and wildlife habitat.

- Alternative B. Increased fire use would restore vegetative composition and structure in areas where fire has been excluded. Impacts from this alternative would be beneficial and moderate to major. No impairment of park resources is expected. Resource managers would critically evaluate the success of proposed burning under this scenario and subsequently fine-tune management prescriptions to achieve resource objectives (e.g., hazard fuel reduction and species conservation).
- Alternative C. This alternative would have similar impacts to Alternative B, but there is the potential to restore certain plant communities more quickly and increase their resilience to disturbance. However, atypically high fuel loads in the National Area, following a recent southern pine beetle epidemic, increase the probability of severe or catastrophic wildfires, uncharacteristic of the natural fire regime. Although the ignition source may be natural, the fire behavior and impact on plant resources would not be considered natural or desirable. Prescribed fires provide managers a level of control and a higher degree of confidence that plant resources will not be adversely impacted.

4.5 Wildlife

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to wildlife were derived from park staff's observations of the effects of fire on wildlife and from literature on fire ecology and wildlife effects. The thresholds of change for the intensity of impacts to wildlife are defined as follows. Impacts can be beneficial or adverse:

Negligible: Impacts occur, but are so minute that they have no observable effect on individuals, populations, or the ecosystems supporting them. Impacts result in parameter measurements that are well within the natural range of variability.

Minor: Impacts are detectable, but parameter measurements are not expected to be outside the natural range of variability and are not expected to have long-term effects on populations or the ecosystems that support them. Long-term effects could occur to individuals. Population numbers for common species may have small, short-term changes. Rare species remain stable even in the short-term.

Moderate: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short periods of time. Changes within the natural range of variability may be long-term. Population numbers for common species may experience small to medium, short-term changes. Rare species may experience short-term changes.

Major: Impacts are detectable and parameter measurements are expected to be outside the natural range of variability for short to long periods of time, or even be permanent. Population numbers for common species may experience large, short-term changes with long-term population numbers substantially altered. Rare species may also experience long-term changes. In extreme cases, species may be extirpated from the park and key ecosystem processes may be disrupted.

Short Term Impacts: Alternative A would benefit established species in the short-term because it would preserve the *status quo*. Under all three alternatives, there may be short-term negative effects from wildland fire to a wide variety of wildlife such as limited mortality, loss of food sources, and the loss of protective cover (Lyon et al. 1978). The most significant effects on fauna as an outcome of Alternatives B and C are the resulting changes in the environment and habitat structure, with ensuing differences in food and cover being the greatest and immediate change, as opposed to direct mortality resulting from prescribed fire activities (Shortess 1986). Wildfires ignited by lightning often occur primarily during the summer months. Under Alternative C, such fires may impact ground-nesting birds.

Long Term Impacts: Although Alternative A might be beneficial in the short-term for a few wildlife species, generally, wildlife species are expected to be more impacted over the long-term as a result of a full suppression policy. Full suppression would result in a decline in habitat diversity and an increase in the probability of high-intensity, stand altering fire, which, by extension, would limit the numbers and types of species that would frequent the National Area.

The lack of fire has unintended ecological effects, leading to the loss of habitat for rare species and the decline of ecosystems (EPA 1998). Many plant and animal species are on the decline because they exist in fire-dependent habitats that haven't burned in decades (EPA 1998). Alternative A would contribute to the continued decline and further impact fire adapted rare species. For example, in the relatively short span of twenty years, under a full suppression policy, over 25 colonies of the fire dependent red-cockaded woodpecker have disappeared from the area (Robert Emmott, personal communication). This species is most frequently associated with the longleaf pine (*Pinus palustris*) forest type but is also found in loblolly (*Pinus taeda*), slash (*Pinus elliotti*), shortleaf (*Pinus echinata*), pond (*Pinus serotina*), and Virginia pine (*Pinus virginiana*). They tend to use older (75-100 years old, depending on species), mature, living pine trees infected with a heartwood decaying fungus (*Phellinus pini*) and prefer open stands with very little midstory vegetation (USDA Forest Service 1995). Through the use of prescribed fire and mechanical fuel reduction projects, Alternative B would help create a diversity of habitat types, including the open forests with the absence of midstory that the red-cockaded woodpecker prefers.

Wild turkeys and ruffed grouse would also benefit from open areas created by prescribed burning and wildland fires. Studies have shown that following a fire, populations of small mammals drop in number but recover quickly, and increase in the following two to three years (Lyons et al. 1978, Masters et al. 1998). An increase in small mammals would benefit those animal and bird species that rely on them for food. Little is known about the reptile and amphibian populations that inhabit the National Area and the effect fire or the absence of fire will have on them on a long-term basis. Data indicate they generally inhabit moist or protected sites, and very few individuals are killed during fires (Means 1981).

Periodic fire tends to favor understory species that require more open habitat. Deer and turkey are game species that benefit from fire (Lyon et al. 1978, Wade 1989). Wildlife benefits from burning are substantial. For example, fruit and seed production is stimulated in some species. Yield and quality increases occur in some herbs, legumes, and hardwood sprouts. Openings are created for feeding, travel, and dusting (Wade 1989). Conversely, Lyon et al. (1978) noted that fire in old growth forest create habit for cavity nesting birds, while at the same time destroying snags that may be favored by the same species. The loss of a specific post-fire or post-logging successional stage may correlate with the decline of those species dependent on the particular vegetation represented. The maintenance of all successional stages through positive management should insure at least minimal levels of all potential species in an area (Lyon et al. 1978).

Alternative C would provide the same benefits as described under Alternative B.

Cumulative Impacts: The prescribed burning program which is currently being implemented in the Daniel Boone National Forest would interact with Alternatives B and C to create a positive cumulative benefit to wildlife in the region.

Methods to Reduce Impacts: Due care would be taken to avoid impacts to ground nesting birds and other wildlife during sensitive periods. Additional protection would be afforded listed species (see Threatened and Endangered Species).

Conclusion:

- Alternative A would allow continued degradation of fire-adapted ecosystems. This would be a moderate, adverse impact to wildlife that depends on these ecosystems. Moderate beneficial effects would accrue to certain other species that depend on open habitat. Park resources would not be impaired.
- Alternative B would have the effect of creating a healthier ecosystem. Increased fire use would restore ecosystems in areas where fire has been excluded. Impacts from this alternative would be beneficial and moderate. No impairment of park resources would occur.

- Alternative C would have similar impacts to Alternative B, but due to the lack of specific knowledge of the fire ecology of the area, this conclusion is not definitive. No impairment would occur under this alternative.

4.6 Threatened and Endangered Plants and Animals

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to threatened and endangered species were derived from park staff's observations of the effects of fire and from literature on fire ecology. The thresholds of change for the intensity of impacts to threatened and endangered species are defined as follows. Impacts can be beneficial or adverse:

Negligible:	An action that could result in a change to a population or individuals of a species or a resource, but the change would be so small that it would not be of any measurable or perceptible consequence.
Minor:	An action that could result in a change to a population or individuals of a species or a resource. The change would be small and localized and of little consequence.
Moderate:	An action that would result in some change to a population or individuals of a species or resource. The change would be measurable and of consequence to the species or resource but more localized.
Major:	An action that would have a noticeable change to a population or individuals of a species or resource. The change would be measurable and result in a severely adverse or exceptionally beneficial impact, and possible permanent consequence, upon the species or resource.

Short Term Impacts: By adhering to existing NPS policies and following established protocol, very little potential impacts to federally and state listed species would occur under all three alternatives. None of the three federally-listed plant species (Cumberland rosemary, Cumberland sandwort, Virginia spiraea) grow in habitats that are likely to be frequently impacted by wildfire or prescribed fire. The habitat types of Cumberland rosemary and Cumberland sandwort are nonfire regimes, meaning there is little or no occurrence of natural fire. Cumberland rosemary grows on river cobble bars and islands along the Big South Fork River. The sand and cobble substrate has a low organic composition that is unlikely to carry fire. Cumberland sandwort grows on moist, cool, sandy-floor rockhouses or sandstone ledges. There is insufficient fuel to carry fire, because the habitat substrate is bare mineral soil and woody understory vegetation cover rarely exceeds 10% (Bryan Wender, personal observation). Virginia spiraea grows in thickets along the flood-scoured riparian margins of the river and second- or third-order streambanks. This habitat type is characterized by a stand-replacing fire regime at long return intervals (< 200 yrs) (Brown and Smith 2000). However, this fire regime is not one that we could safely replicate with a fire prescription. Payne and Shea (1994) predict that fire would not significantly impact Virginia spiraea populations. Measures (discussed below) would be taken to ensure protection of all known occurrences of these species.

Alternative A, by increasing the potential for castastrophic fire, may increase the potential need to use fire suppressant chemicals. Adverse effects to threatened and endangered fish and mussels could occur if chemicals were applied inappropriately or accidentally introduced to waterways. The use of prescribed fire as proposed under Alternatives B and C is not expected to benefit aquatic habitat, but it could have adverse effects such as causing a slight increase in turbidity (Wade 1989). Riparian zone (streamside) vegetation would be excluded from prescribed burns to protect habitat and water quality. Riparian zones would also be protected whenever possible from the impacts of wildfire. Fire suppressant chemicals would not be applied within 300 feet of any waterway. Prescribed fire and mechanical fuel reduction around developed areas and the National Area boundary would minimize risks to life and property, thereby reducing the need for fire suppressant chemicals.

NPS completed a Biological Assessment for each of the 17 federal threatened and endangered species. By complying with the described mitigation actions and conditions, the proposed fire management actions were determined to have no effect or to not likely adversely affect any of the evaluated species. The FMP and BA detail the mitigation measures that will minimize impacts to aquatic organisms from silt, ash, sediment, and chemical inputs that may result from fire management activities. Mitigation measures are also presented for terrestrial plants and animals.

Long Term Impacts: American chaffseed and the red-cockaded woodpecker are federally listed species from the area that are known to benefit from fire. Pitcher plants (*Sarracenia spp*) are also known to benefit from fire. Moderate fires are necessary to reduce encroachment of competitive species and release nutrients to stimulate growth (Hessl 1995, FEIS 1990). By further restricting fire from the land, Alternative A would perpetuate the decline of habitat known to be favored by these and other species that benefit from periodic fire and would lead to accumulations of hazard fuels, resulting ultimately in the possibility of large scale, high intensity wildland fires. Fires of this type would present an increased threat to these species by consuming duff and mineral soils that may harbor remnant plants and seeds, or stress and destroy rhizomes of plant species such as the green pitcher plant, thus reducing or even eliminating the possibility of regeneration and perpetuation. Catastrophic fire that results in high canopy mortality could also alter the cool, moist microclimate required by Cumberland sandwort and associated rockhouse rare species. Increased solar radiation and subsequent evaporation could cause sandwort populations to retreat to protected microhabitats.

Based on current knowledge, Alternative B best protects these species in the long-term because that alternative would reduce threats from large scale, high intensity wildland fire and create favorable habitats, consistent with known ecological conditions required by many listed species. Area resource managers would complete surveys prior to conducting a prescribed burn to determine the presence or absence of these species and formulate a plan to protect the site from unwanted fire effects.

Although similar surveys would be conducted under Alternative C, areas burned by lightning ignited fires that were allowed to burn under controlled conditions, could, in all likelihood, not be surveyed prior to ignition. Upon the completion of additional fire ecology studies, resource managers will have a more complete understanding of the ecology of the area and the impact of wildland fires on many more species. This will allow them to better determine over-all ecological relationships.

Cumulative Impacts: Activities currently underway on the Daniel Boone National Forest to restore habitat for the red-cockaded woodpecker would complement the actions proposed under Alternatives B and C. Alternative A would reduce the effectiveness of the Forest Service prescribed burn program by reducing the amount of available habitat and by allowing continued accumulation of hazard fuels that could pose a threat to habitat that the Forest Service creates.

Methods to Reduce Impacts: Known locations of federal and state listed species would be protected during wildland fire suppression operations unless it is known that fire enhances a particular species. All known listed species in a burn unit would be evaluated prior to a prescribed burn and protected as specified in the prescribed burn plan. All such measures would be identified in prescribed burn plans and in a site-specific, pre-attack wildland fire suppression plan.

In addition to the constraints to fire suppression activities described in **2.0 Alternatives**, for both wildland and prescribed fires, the following operational measures will be taken to minimize siltation, erosion, chemical inputs to waterways, and adverse effects on rare species and sensitive habitats:

- NPS will develop annual burn plans and will complete Section 7, Endangered Species Act consultation with USFWS to evaluate each burn plan.
- NPS will regularly provide to USFWS updated monitoring data on T&E species in or near fire treatment areas.
- When available, a Resource Advisor will respond to wildland fires and report to the Incident Commander (IC). The Resource Advisor will use GIS and knowledge of the resources to advise the IC of potential impacts of the fire and proposed suppression tactics on T&E species/habitat.
- Mechanical fuel reduction will be used to create a fire break around Charit Creek, thereby reducing the need for retardant use in the event of wildland fire in the vicinity.
- Hazard-fuel breaks will be maintained along portions of the National Area’s wildland-urban interface (WUI). These WUI buffers are intended to reduce the risk of wildland fire to private property adjacent to the National Area. Properly maintained WUI buffers will increase the potential to contain wildland fires within

National Area boundaries, thereby reducing the potential need for retardant use. WUI breaks will be created and maintained using prescribed fire and mechanical means.

- Prescribed fire treatment areas will not be designated in areas of the park where there is high potential for coal fires or fires that may adversely impact oil and gas facilities.
- Periodic and post-treatment monitoring of T&E species and habitats will allow for more careful analysis of treatment effects. Future management actions will be adapted to reflect the better understanding of fire effects provided through monitoring.
- Impacts to mussel populations will be further mitigated through an existing mussel augmentation plan. This plan calls for mussel populations to be augmented via culturing and propagation of gravid females from the Big South Fork River or other regional parental stock (Biggins et al. 2001). These actions would 1) increase the likelihood of recruitment in currently occupied habitat; 2) increase the expansion rate of species into suitable, unoccupied historical habitat within the Big South Fork River; 3) decrease the potential for local pollution events to impair all collective populations of mussels within or among species. Furthermore, in the event of impairment to mussel populations from wildland fire, prescribed fire, or fire suppression activities, the current augmentation plan provides a mechanism to restore affected populations.
- Because of the scarcity of mature shortleaf pine (*Pinus echinata*) in the National Area, following a recent southern pine beetle epidemic, efforts will be made to protect residual mature shortleaf pines stands from destructive crown fires. Controlled fire prescriptions will be designed to eliminate encroaching hardwoods and white pine (*Pinus strobus*) while minimizing shortleaf pine mortality.
- To minimize impacts of wildland and prescribed fire on potential Indiana bat roosting habitat, NPS will implement these measures when feasible:
    - In each prescribed fire treatment area, snags of sufficient size (> 30 cm) to be roosting sites will be protected by raking a fireline around the snag base. The exception is when snags pose a threat to firefighter safety.
    - During and after wildland fire suppression, snags will be removed only in proximity to firelines, and then only when snag presence poses a risk to fire containment or to firefighter safety.
    - Prescribed fires in forested habitats will be conducted from November 1 to May 15, when non-flying young are less likely to be present in maternity roosts.
    - Mist net surveys are being conducted in 2004 to confirm presence/absence of Indiana bats. NPS will consult with USFWS as appropriate if survey results indicate presence of Indiana bats in the National Area.

Conclusion:

- Alternative A. Under this alternative a catastrophic wildfire could lead to sedimentation and turbidity in the river, so impacts to threatened and endangered aquatic species would be moderate. Impacts to threatened and endangered plant species would also be moderate due to continued degradation of terrestrial habitats. There would be no impairment of park threatened and endangered species resulting from this alternative.

- Alternative B would have negligible effects to threatened and endangered aquatic species, and moderate, beneficial impacts to threatened and endangered plant species. No impairment to threatened and endangered species would occur.
- Alternative C would have negligible effects to threatened and endangered aquatic species. Because there would be less control over where prescribed natural fire occurs, this alternative would have minor, beneficial effects to threatened and endangered plant species. This alternative would not constitute an impairment to threatened and endangered species.

4.7 Cultural Resources

Methodology and Intensity Thresholds
In order for an archeological resource, an historic structure, or Cultural Landscape to be eligible for the National Register of Historic Places it must meet one or more of the following criteria of significance: A) associated with events that have made a significant contribution to the broad patterns of our history; B) associated with the lives of persons significant in our past; C) embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction; D) have yielded, or may be likely to yield, information important in prehistory or history.

An archeological resource, an historic structure, or a cultural landscape must also possess integrity of location, design, setting, materials, workmanship, feeling, association (*National Register Bulletins: Guidelines for Evaluating and Registering Archeological Properties; How to Apply the National Register Criteria for Evaluation*).

For purposes of analyzing potential impacts to archeological resources, historic structures/buildings, and landscapes, the thresholds of change for the intensity of an impact are defined as follows:

Negligible: Impact is at the lowest levels of detection - barely measurable with no perceptible consequences, either adverse or beneficial, to archeological resources or historic structures or remnant landscape features. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Minor: Adverse impact - disturbance of a site(s) results in little, if any, loss of significance or integrity and the National Register eligibility of the site(s) is unaffected. For purposes of Section 106, the determination of effect would be *no adverse effect*.

Beneficial impact – maintenance and preservation of a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect.*

Moderate: Adverse impact - disturbance of a site(s) does not diminish the significance or integrity of the site(s) to the extent that its National Register eligibility is jeopardized. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact – stabilization of a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect*.

Major: Adverse impact – disturbance of a site(s) diminishes the significance and integrity of the site(s) to the extent that it is no longer eligible to be listed in the National Register. For purposes of Section 106, the determination of effect would be *adverse effect*.

Beneficial impact – active intervention to preserve a site(s). For purposes of Section 106, the determination of effect would be *no adverse effect*.

Short Term Impacts: Under all three alternatives there are no known short-term impacts to cultural sites that could not be resolved using mechanical treatment methods in conjunction with an approved Integrated Pest Management Plan. Examples of the mechanical methods include mowing grass near cultural sites that could be damaged by fire, and cutting and removing brush and other woody materials to form a buffer between the structure or site to be protected and the forest or grassland.

Long Term Impacts: Under Alternative A, cemeteries, houses, outbuildings, fences, historic orchards, and other structures and improvements at cultural sites scattered throughout the National Area would be placed at greater risk as heavy accumulations of fuels continue to increase and encroach on a site or structure. High intensity fires occurring near the National Area boundary would increase the need for the use of a tractor-plow and other heavy equipment to halt the spread of fire. The use of such equipment could damage previously unknown archeological resources located below the surface. In the event a wildfire was to burn heavy accumulations of vegetation in cemeteries, headstones or other grave markers could be damaged or lost. Cultural landscapes, such as old fields, fences, historic ornemental plants, orchards, pens and pasturelands may be lost due to the encroachment of woody species.

Through the manipulation of fuels described in Alternative B, sites would be safeguarded by removing accumulations of fuel from the vicinity, thereby reducing the threat of catastrophic wildland fire and enhancing control options. This alternative would also provide a cost-effective means of maintaining the cultural landscape, including old fields, landscape features, and pasturelands so that future generations would be better able to understand the story of subsistence farming in the Plateau region.

Although the impacts would be similar under Alternative C, wildfires that are allowed to burn under controlled conditions might impact unrecorded cultural sites. Under all three alternatives, heat generated by a wildland fire may unavoidably impact exposed materials at archeological sites.

Cumulative Impacts: Increased fire use by the Daniel Boone National Forest could have a cumulative beneficial effect to cultural resources of the Cumberland Plateau. As described above, under Alternatives B and C, cultural sites would be safeguarded by removing accumulations of fuel from the vicinity, thereby reducing the threat of catastrophic wildland fire.

Methods to Reduce Impacts: During wildland fire suppression operations, an archeologist or other trained individual would be assigned to provide guidance to suppression forces. Prior to conducting a prescribed burn, archeological surveys would be conducted to determine if cultural resources were present. The National Park Service Management Guideline number 28 (Chapter 5, p70) requires an archeologist "review and assess all proposed undertakings that could affect archeological resources to ensure that all feasible measures are taken to avoid resources, minimize damage to them, or recover data that otherwise would be lost". To effectively preserve any archeological resources that may be threatened by actions proposed in this Fire Management Plan all of the proposed areas would be investigated and assessed by an archeologist to determine the presence and integrity of any archeological resources. Any archeological sites or resources discovered during fire management operations <u>*that retain archeological integrity*</u> (i.e. that have not been completely destroyed by past farming practices) in the 15 agricultural fields selected for fire management in this plan, would be avoided or protected with fire breaks

Cultural site protection efforts could range from avoidance to assigning engines to protect structures and other cultural properties and features that could be damaged by fire. Plant Features associated with Cultural Landscapes would be protected by various methods selected through consultation with the Cultural Resources Management Specialist. Methods used to protect plants may include using foam, mowed buffers and fire lines, and mechanical barriers. Protection measures would be evaluated for their effectiveness and all fire management work around National Register eligible structures and Cultural Landscape features would be coordinated with the CRM Specislist. The long term goals for the Cultural Landscapes would be to produce landscape configurations that existed at these locations during the periods of historic significance. All such measures would be identified in the prescribed burn plans and in a site-specific, pre-attack wildland fire suppression plan.

The concurrence of the appropriate State Historic Preservation Officer (SHPO) would be obtained, at the annual Cultural Resource Management meetings that have been held at Big South Fork since 1986. The present goals of this Fire Management Plan were discussed with the Tennessee State Preservation Office representatives as recently as 1/23/03.

Conclusion:

- Alternative A: The greatest threat to cultural resources is large-scale, high intensity wildland fire that could lead to the loss of historic structures, fields and pasturelands, and the disturbance of previously unknown archeological sites by fire plows. This type of fire is a possibility under Alternative A. In addition, under this alternative, the cultural landscape would slowly disappear as fields and pasturelands, which could not be treated in a cost-effective manner, were taken over by trees and other woody species. This phenomenon has already occurred at cultural sites and landscapes like the No Business community. Therefore, adverse impacts associated with Alternative A would be major, but would not likely lead to impairment of the park's cultural resources.
- Under Alternative B, there would be a reduced chance of a catastrophic fire, plus this alternative would provide a cost-effective means of perpetuating the cultural sites. Adverse impacts from Alternative B would be minor. Beneficial impacts would be major. There would be no impairment of the park's cultural resources.
- The impacts associated with Alternative C would be similar to those from Alternative B. There would be no impairment.

4.8 Visitor Use

Methodology and Intensity Thresholds

Analyses of the potential intensity of impacts to visitor use were derived from park staff's observations of the effects fire on visitor use. The thresholds of change for the intensity of impacts are defined as follows:

Negligible:	The impact is barely detectable, and/or will affect few visitors.
Minor:	The impact is slight but detectable, and/or will affect some visitors.
Moderate:	The impact is readily apparent and/or will affect many visitors.
Major:	The impact is severely adverse or exceptionally beneficial and/or will affect the majority of visitors.

Short Term Impacts: Under all three alternatives, visitors may be impacted by low concentrations of smoke and certain areas of the National Area may be temporarily closed for visitor safety reasons.

Long Term Impacts: Alternative A would have little impact on visitor use except for large wildland fire occurrences. During these events, large sections of the National Area may have to be closed for extended periods.

Under Alternative B the continued use of short-term restrictions would continue indefinitely. However, many of these restrictions would involve remote sections of the National Area. Visiting school groups that conduct field trips during the spring and fall could be impacted because their field activities coincide with the primary fire seasons.

Impacts identified for Alternative B would be similar for Alternative C. Visitors may be impacted longer when lightning ignited fires are allowed to burn to achieve resource benefit. Certain sections of the National Area may have to be closed for extended periods.

Cumulative Impacts: There are no known cumulative impacts to visitor use from the three alternatives.

Methods to Reduce Impacts: When it would be necessary to close an area during wildland fire suppression operations and prescribed fire operations in order to provide for visitor protection, all affected trailheads would be signed so that closures would be easily recognized. Measures to be taken to provide for visitor safety, such as posting traffic warning signs and public notices, would be identified in the prescribed burn plan. Interpretative programs would be presented, when appropriate, to better inform the public of the role of fire in the ecosystem and how fire can be used to accomplish management objectives. The National Area would work with adjacent landowners and the Forest Service to coordinate activities so that the visiting public would be impacted as little as possible.

Conclusion:

- Alternative A. Due to the higher risk of a catastrophic fire under this alternative, adverse impacts would be moderate. No impairment would occur.
- Adverse impacts to visitor use resulting from the implementation of Alternative B would be negligible, and no impairment to park resources would occur.
- Visitor use impacts associated with Alternative C would also be negligible, and there would be no impairment of park resources.

Table 1: Impact Topics and Alternatives Summary Table

Impacts	Alternative A	Alternative B	Alternative C
Soils	Short term: Increased nutrients available on limited basis. Organic matter may be consumed and soil altered at fire site. Long term: Increased risk that organic matter may be consumed and soils altered as fuel loads increase. Soil productivity would decrease. Increased likelihood of soil erosion following a fire. Conclusion: Adverse, moderate impacts	Short term: Increased nutrients available over a larger area. Biomass may be increased. Long term: Nutrient recycling process would be sped up. Soil protection from the effects of high intensity fires would be increased. Conclusion: Beneficial, moderate impacts	Short term: Same as Alt B. Long term: Because more acres would be treated, the effects described for Alternative B would be increased. Conclusion: Beneficial, moderate impacts; some unknowns
Air Quality	Short term: Very minor short-term impact on visibility. Impacts to health limited to fireline. Regional AQ only impacted if large fire. Long term: As fuel loading increases, fires will tend to be larger. More particulate matter will be released, resulting in increased reduced visibility for longer periods of time and increased health risks. Conclusion: Adverse, moderate impacts	Short term: Greater short-term impacts due to increased fire. Impacts to health and regional air quality could be better managed. Long term: The potential for long duration fires would decrease as fuel loading is reduced. Impacts would be lessened due to the ability to schedule prescribed burns. Regional AQ standards be safe-guarded. Conclusion: Adverse, minor impacts	Short term: Greatest short-term impacts due to increased use of fire and that fires would burn longer. Long term: Impacts similar to Alternative B. Increased fire use may further reduce fuel loading and reduce the likelihood of large fires by creating fuel breaks, etc., reducing the possibility of large scale events. Conclusion: Adverse, minor impacts

Table 1: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C
Water Quality	<u>Short term:</u> Possibility of runoff on drier sites. Possibility of short term contamination from fire retardant. <u>Long term:</u> Groundwater yields may be slightly reduced. Increased likelihood of high intensity fires that could impact soils and increase run off. The resulting run off could lead to increased turbidity and sedimentation. Increased likelihood of contamination by retardant as fires become larger and managers are forced to use airtankers to save lives and property. <u>Conclusion</u>: Adverse, moderate impacts	<u>Short term:</u> Similar impacts to Alternative A. <u>Long term:</u> Proactive use of fire under controlled conditions would reduce loss of ground cover and increase rain absorption. The possibility of impact to water courses would be reduced. Ground water yields could be increased slightly. <u>Conclusion</u>: Adverse, minor to moderate impacts	<u>Short term:</u> Same impacts as Alternative A. <u>Long term:</u> Results similar to Alternative B would be expected. <u>Conclusion</u>: Adverse, minor Impacts; some unknowns

Table 1: Impact Topics and Alternatives Summary Table (Continued

Impacts	Alternative A	Alternative B	Alternative C
Vegetation	Short term: Plants may be injured or killed. Possibility of exotic species becoming established. Certain trees may be more susceptible to disease. than under Alternatives A&B. Long term: The vegetation would become fire-intolerant. Ladder fuels would increase. Trees and other woody species more likely to invade cultural landscapes. Non-native grasses would out-compete native grasses. Structures and improvements be placed at risk from wildfire. Conclusion: Adverse, major impacts	Short term: Impacts similar to Alternative A would be expected. Accumulations of fuel may increase as a result of top-killing trees and shrubs. Long term: A mosaic of vegetation would be created. Fire adapted species would be less impacted. Stands of pine would be less susceptible to infestations of insects. The possibility of high intensity fires would be reduced. Cultural landscapes would be maintained in a cost effective manner. Native grasses could out compete & replace exotic grasses. Conclusion: Beneficial, moderate to major impacts	Short term: Impacts similar to Alternative B would be expected. The increased accumulation of fuel would be expected to be higher. Long term: Impacts similar to those identified under Alternative B would be expected. Conclusion: Beneficial, moderate to major impacts; some unknowns

Table 1: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C
Wildlife	<u>Short term:</u> The lack of fire would benefit existing species. Limited mortality. Loss of food sources and loss of protective cover a possibility. <u>Long term:</u> The decline in habitat diversity would limit the number and type of species. Fire adapted species would be greatly impacted. Existing species such as deer would be impacted as browse becomes limited. The numbers of animals would be reduced. <u>Conclusion</u>: Adverse, moderate impacts to some species; beneficial moderate effects to others	<u>Short term:</u> Limited mortality, loss of food sources and loss of protective cover a possibility. <u>Long term:</u> Possibility of competition from new species as habitats change. Wildlife such as deer and turkey would benefit and increase in number. Birds and animals that prey on small mammals would have the possibility of increased food sources. The edge effect and the mosaic created would benefit a wider range of wildlife. <u>Conclusion</u>: Beneficial, moderate impacts	<u>Short term:</u> Limited mortality, loss of food sources and loss of protective cover a possibility. Due to timing of lightning ignitions, fires may impact ground nesting birds. <u>Long term:</u> The effects are expected to be the same as those listed for Alternative B. <u>Conclusion</u>: Beneficial, moderate impacts; some unknowns

Table 1: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C
Threatened & Endangered Species	Short term: Little potential for impact to T&E species except for potential mortality of fish or mussels if retardants/foams introduced to waterways. Long term: The habitat known to be favored by fire adapted species would be further impacted. As a result, listed species may be lost. Severe fires may destroy seed sources and damage rhizomes. Conclusion: Adverse, moderate impacts	Short term: Little potential for impact to T&E species except for potential mortality of fish or mussels if retardants/foams introduced to waterways. Long term: Sensitive habitats would be protected from high intensity fires. Habitats preferred by fire adapted species would be perpetuated, increasing the possibility that listed species would recover. Conclusion: Adverse, minor impacts to aquatic species; moderate, beneficial impacts to T&E plants	Short term: Little potential for impact to T&E species except for potential mortality of fish or mussels if retardants/fo introduced to waterway Long term: The effects are expected to be the same as those listed for Alternative B. Until additional fire ecological studies have been completed, there is a slight risk that unknown cohorts of T&E species could be adversely impacted. Conclusion: Adverse, minor impacts to aquatic species; minor, beneficial impacts to T&E plants

Table 1: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C
Cultural Resources	Short term: There are no known short term impacts. Long term: Historic structures would be at greater risk from wildland fire. As costs increased, the number of acres of cultural landscape that could be treated would decrease. The cultural landscape slowly change as woody species took over open fields. Conclusion: Adverse, major impacts	Short term: There are no known short term impacts. Long term: Historic structures would be better protected from wildland fire through fuel management. Cultural landscapes would be perpetuated in a cost efficient manner. The possibility of cultural values being damaged by suppress-ion actions would be reduced. Conclusion: Adverse, minor impacts; Beneficial, major impacts	Short term: There are no known short term impacts. Because lightning ignited fires would burn in areas that have not been surveyed, a fire may impact a previously unrecorded site. Long term: The effects are expected to be the same as those listed for Alternative B. Conclusion: Adverse, minor impacts; Beneficial, major impacts

Table 1: Impact Topics and Alternatives Summary Table (Continued)

Impacts	Alternative A	Alternative B	Alternative C
Visitor Use	Short term: Visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. Long term: The extent of the closures may be longer during large fire events. Conclusion: Adverse, moderate impacts	Short term: Visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. More individuals may be impacted as a result of the prescribed fire operations. Long term: For a longer period of time closures would continue. Increased opportunity to explain role of fire in the ecosystem. Conclusion: Negligible impacts	Short term: Visitors may be impacted by smoke in the immediate vicinity of a wildfire. There may be temporary closures. The closures may be longer under this alternative. Long term: The closures would continue for a longer period of time. The closures may be longer when lightning fires are allowed to burn. Increased opportunity to explain role of fire in the ecosystem. Conclusion: Negligible impacts

CONSULTATION AND COORDINATION

The Draft Fire Management Plan and associated Environmental Assessment from Colorado National Monument were used in the development of this plan. These two documents were prepared by a work group to serve as a guide for small to medium sized parks that do not have a heavy fire load. The approved Fire Management Plan and associated Environmental Assessment for Great Smoky Mountains National Park were consulted to provide guidance. The Fire Management Plan for Mammoth Cave National Park: Part I Physical Environment, Terrestrial Ecosystems and Fire History (Campbell 1999) was also used in the development of this Fire Management Plan and Environmental Assessment.

Under the provisions of the Endangered Species Act of 1973, as amended, the Service must work with other federal and state agencies to protect, conserve and enhance the continued existence of any endangered species or threatened species. Any actions that may impact these species are subject to review by the U.S. Fish and Wildlife Service. A copy of this document will be made available to the U.S. Fish and Wildlife Service for consultation under Section 7 of the Endangered Species Act.

The National Historic Preservation Act, as amended in 1992 (16 USC 470 *et seq.*); the National Environmental Policy Act; the NPS Cultural Resource Management Guideline (1994), and NPS Management Policies (2000) require the consideration of impacts on cultural resources listed, or eligible for listing, on the National Register of Historic Places. The actions described in this document are also subject to Section 106 of the National Historic Preservation Act, under the terms of the 1995 Programmatic Agreement among the NPS, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers. Impacts to cultural resources therefore have been analyzed and will be reviewed in accordance with applicible laws, policies and agreements.

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APPENDIX EA-A: GLOSSARY OF TERMS

Appropriate Management Response: Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Catastrophic Wildfire: A large scale, high-intensity wildland fire that could result in high plant mortality, remove the majority of ground cover over a large area, possibly damage or destroy structures and other property, and/or severely impact water and air quality.

Closed Area: An area in which specified activities or entry are temporarily restricted to provide for to public safety or to reduce risk of human-caused fires.

Closure: Legal restriction, but not necessarily elimination, of specified activities such as smoking, camping, or entry that might cause fires in a given location.

Confine: Confinement is the strategy employed in appropriate management responses where a fire perimeter is managed by a combination of direct and indirect actions and use of natural topographic features, fuel, and weather factors.

Fire Effects: The physical, biological, and ecological impacts of fire on the environment.

Fire Management: Activities required for the protection of burnable wildland values from fire and the use of prescribed fire to meet land management objectives.

Fire Management Plan (FMP): A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

Fire Management Unit (FMU): Any land management area definable by objectives, topographic features, access, values-to-be-protected, political boundaries, fuel types, or major fire regimes, etc., that set it apart from management characteristics of an adjacent unit. FMU's are delineated in FMP's. These usits may have dominant management objectives and preselected strategies assigned to accomplish these objectives.

Fire Retardant: Any substance except plain water that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

Fire Use: The combination of wildland fire use and prescribed fire applications to meet resource objectives.

Hazard: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.

Hazard Fuel Reduction: **Any treatment of living and dead fuels that reduces the threat of ignition and spread of fire.**

Heavy fuels: **Fuels of large diameter such as snags, logs, large limbwood, which ignite and are consumed more slowly that flash fuels.**

Initial Attack: An aggressive suppression action consistent with firefighter and public safety and values to be protected.

National Wildfire Coordinating Group (NWCG): A group formed under the direction of the Secretaries of Interior and Agriculture to improve the coordination and effectiveness of wildland fire activities, and provide a forum to discuss, recommend appropriate action, or resolve issues and problems of substantive nature.

Preparedness: Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination.

Prescribed Fire: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

Prescribed Fire Plan: A plan required for each fire application ignited by managers. It must be prepared by qualified personnel and approved by the appropriate agency administrator prior to implementation. Each plan will follow specific agency direction and must include critical elements described in agency manuals.

Prescription: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economical, public health, environmental, geographic, administrative, social, or legal considerations.

Wildfire: An unwanted wildland fire.

Wildland Fire: any nonstructure fire, other than prescribed fire, that occurs in the wildland. *This term encompasses fires previously called both wildfires and prescribed natural fires.*

Wildland Fire Management Program: The full range of activities and functions necessary for planning, preparedness, emergency suppression operations, and emergency rehabilitation of wildland fires, and prescribed fire operations, including fuels management to reduce risks to public safety and to restore and sustain ecosystem health.

Wildland Fire Situation Analysis (WFSA): A decision making process that evaluates alternative management strategies against selected safety, environmental, social, economic, political, and resource management objectives.

Wildland Fire Suppression: An appropriate management response to wildland fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire.

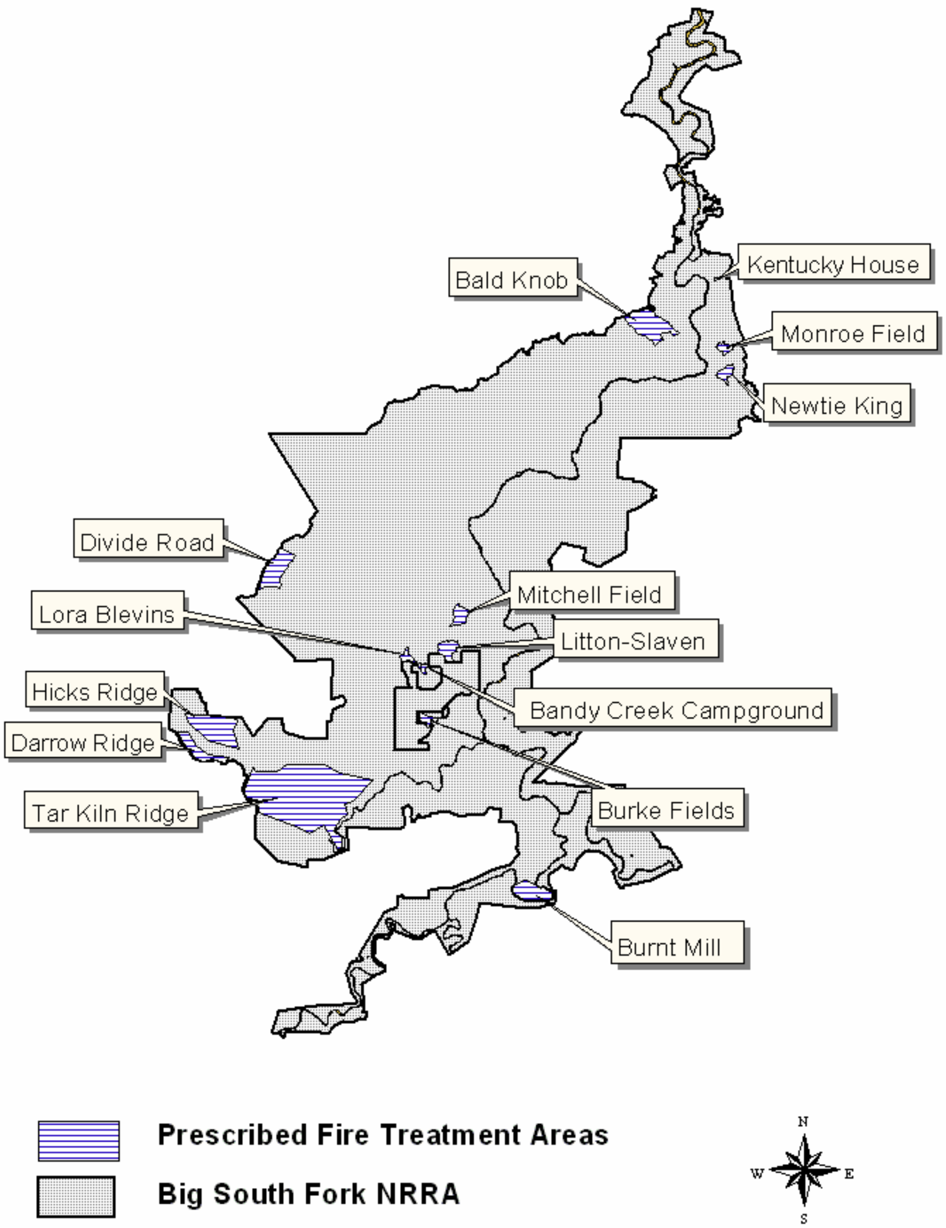
Wildland Fire Use: The management of naturally ignited wildland fires to accomplish specific prestated resource management objectives in predefined geographic areas outline in FMP's.

APPENDIX EA-B. **Proposed Prescribed Fire Treatment Areas at Big South Fork NRRA.**

PFTA	Acres	Treatment Objectives	Dominant Vegetation Classes
Bald Knob	630	Hazard fuel reduction; restore native plant community	Sub-xeric forest; Mixed-mesic forest
Bandy Creek Campground	57	Hazard fuel reduction	Sub-xeric forest; Mixed-mesic forest
Bear Branch Ridge	900	Hazard fuel reduction; restore native plant community	Xeric woodland; Sub-xeric forest
Burke Fields	45	Hazard fuel reduction; restore native plant community	Grassland; Sub-xeric forest
Burnt Mill Loop	145	Hazard fuel reduction	Sub-xeric forest; Mixed-mesic forest; Riparian forest
Charit Creek	11	Hazard fuel reduction; maintain cultural landscape	Mixed-mesic forest; Riparian forest
Darrow Ridge	300	Hazard fuel reduction; restore native plant community	Upland oak-pine woodland
Divide Road	450	Hazard fuel reduction	Sub-xeric forest
Gar Blevins	540	Hazard fuel reduction; restore native plant community	Sub-xeric forest; Mixed-mesic forest
Gobblers Knob	3400	Hazard fuel reduction; restore native plant community	Sub-xeric forest
Hicks Ridge	715	Hazard fuel reduction; restore native plant community	Xeric woodland; Sub-xeric forest
Hurricane Ridge	1500	Hazard fuel reduction; restore native plant community	Upland oak-pine woodland
Kentucky House	1	Hazard fuel reduction to protect structure	Sub-xeric forest
Lora Blevins	77	Restore/maintain cultural landscape; restore native plant community	Grassland; Upland oak-pine woodland
Ledbetter Fields and Vicinity	450	Hazard fuel reduction; restore native plant community	Grassland; Sub-xeric forest
Litton-Slavens	185	Maintain cultural landscape; restore native plant community	Sub-xeric forest; Mixed-mesic forest

PFTA	Map ID	Acres	Treatment Objectives	Dominant Vegetation Classes
Mitchell Fields	MiF	35	Hazard fuel reduction; restore native plant community	Grassland; Sub-xeric forest
Monroe Fields	MoF	80	Hazard fuel reduction; restore native plant community	Grassland; Sub-xeric forest
Newtie King	NK	120	Hazard fuel reduction; maintain cultural landscape; restore native plant community	Grassland; Upland oak-pine woodland; Xeric woodland
Tar Kiln Ridge	TKR	3900	Hazard fuel reduction; restore native plant community	Upland oak-pine woodland

Big South Fork NRRA Prescribed Fire Treatment Areas



APPENDIX EA-C. Vegetative Species Common to Big South Fork NRRA and Their Relationship to Fire

Common Name	Scientific Name	Habitat	Fire and Disturbance Related Comments
Red maple	Acer rubrum	Moist sites and floodplains	Fire intolerant Has the ability to resprout Common on burnt lands
Sugar maple	Acer saccharum	Mesic closed canopy forests	Sensitive to fire
Yellow buckeye	Aesculus octandra	Mixed forests	Anticipated top-killed by fire. Recovers rapidly
Bitternut hickory	Carya cordiformis	Oak-Hickory Shortleaf pine	Saplings easily damaged Older trees can survive
Pignut hickory	Carya glabra	Oak-Hickory Shortleaf pine	Readily damaged by fire Will resprout
Shagbark hickory	Carya ovata	Oak-Hickory Shortleaf pine	All sizes susceptible to damage by fire Will resprout after fire
Beech	Fagus grandifolia	Oak-Hickory Shortleaf pine	Fire intolerant Will resprout after fire
Black walnut	Juglans nigra	Oak-Hickory Shortleaf pine	Well adapted to fire
Sweet gum	Liquidambar styraciflus	Oak-Hickory	Top-killed by fire Susceptible to repeated fire
Tulip popular	Litodendron tulipifera	Oak-Hickory Shortleaf pine	Susceptible to fire damage Fire will kill small trees More resistant to fire damage than oaks. Fire can enhance establishment
Magnolia	Magnolia spp	Mesic sites	Assumed to be quite fire resistant Sprouts vigorously when top-killed
Black gum	Nyssa sylvatica	Oak-Hickory-Pine	Assumed to be well adapted to fire Prolific resprouter
White pine	Pinus strobus	Oak-Hickory-Pine	Moderately resistant to fire Younger trees more susceptible, older not so
White oak	Quercus alba	Oak-Hickory	Moderately resistant to fire Will survive periodic fire Exclusion of fire has inhibited growth

Common Name	**Scientific Name**	**Habitat**	**Fire and Disturbance Related Comments**
Northern red oak	Quercus rubra	Oak-Hickory	Well adapted to periodic fire
Post oak	Quercus stellata	Oak-Hickory	Moderately resistant to fire Resprouts vigorously If fire is infrequent or absent, so is Post oak
Black oak	Quercus velutina	Oak-Hickory	Moderately resistant to fire Small trees easily top-killed Resprouts from root collar
White basswood	Tilia heterophylla	Oak-Hickory Maple-Beech-Birch	Assumed to be resistant to fire Resprouts
Hemlock	Tsuga canadensis	Oak-Hickory Maple-Beech-Birch	Susceptible to fire, especially seedlings and saplings Most fire-sensitive mesophytic tree species in range
Dogwood	Cornus florida	Oak-Hickory-Pine	Well adapted to fire Resprouts vigorously
American holly	Ilex opaca	Shortleaf pine Oak-Hickory	Very susceptible to fire May resprout from root crown
Rhododendron	Rhododendron spp	Occurs in oak woods that periodically experiences fire	Assumed to be sensitive to fire Able to resprout from root crown
Hucleberry	Gaylussacia spp	Oak-Hickory	Assumed to be fire tolerant Top-killed but stimulated by fire. Rhizomes are protected from heat
Mountain laurel	Kalmia latifolia	Oak-Hickory-Pine	Moderately well adapted to fire. Resprouts from root collar

Source: USDA Forest Service. 1998. Fire Effects Information System. Rocky Mountain Research Station – Fire Sciences Lab. Missoula, Montana

APPENDIX EA-D: Selected Animal Species Common to Big South Fork NRRA and Their Relationship to Fire

Common Name	Scientific Name	Fire and Disturbance Related Comments
Bobcat	Lynx rufus	Fire may improve foraging habitat and prey base. Mobil enough to escape from a fire.
White-tail deer	Odocoileus virginianus	Benefit through improved habitat and improved nutritional quality of forage
Gray fox	Urocyon cinereoargenteus	Fires that reduce brush cover will decrease habitat. Fires generally increase the amount of prey and improves predator efficiency.
Black bear	Ursus americanus	Many bear foods are enhanced by fire
Ruffed grouse	Bonasa umbellus	Fires early in the season may consume nest and early hatchlings. Fire can open forest to remove hiding places for predators, enhance growth of important food species and control parasites.
Turkey	Meleagris gallopavo	Spring fires may destroy nests but once birds are old enough to fly, they can easily escape. Fire can stimulate important food sources, reduce predator cover, reduce litter to make food more accessible, and control parasites such as ticks and fleas.
Red-cockaded woodpecker	Picoides borealis	Fire plays an integral role in maintaining habitat both for colony sites and foraging.

Source: USDA Forest Service. 1998. Fire Effects Information System. Rocky Mountain Research Station – Fire Sciences Lab. Missoula, Montana

APPENDIX EA-E. Federal endangered, threatened, and candidate species known or potentially occurring in or adjacent to Big South Fork NRRA.

Common Name	Scientific Name	Federal Status	Confirmed Present
Cumberland bean	*Villosa trabalis*	Endangered	Yes
Cumberland elktoe	*Alasmidonta atropurpurea*	Endangered	Yes
Cumberlandian combshell	*Epioblasma brevidens*	Endangered	Yes
Little-wing pearlymussel	*Pegias fabula*	Endangered	Yes
Tan riffleshell	*Epioblasma florentina walkeri*	Endangered	Yes
Oyster mussel	*Epioblasma capsaeformis*	Endangered	No
Fluted kidneyshell	*Ptychobranchus subtentum*	Candidate	Yes
Clubshell	*Pleurobema clava*	Endangered	No
Duskytail Darter	*Etheostoma percnurum*	Endangered	Yes
Blackside dace	*Phoxinus cumberlandensis*	Threatened	No
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No
Indiana bat	*Myotis sodalis*	Endangered	Yes[2]
Cumberland sandwort	*Arenaria cumberlandensis*	Endangered	Yes
Cumberland rosemary	*Conradina verticillata*	Threatened	Yes
White fringeless orchid	*Platanthera integrilabia*	Candidate	No
American chaffseed[1]	*Schwalbea americana*	Endangered	No
Virginia spiraea	*Spiraea virginiana*	Threatened	Yes

[1]Extirpated from Kentucky and Tennessee.

[2]A single male bat was observed in 1981; none have been observed since.